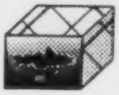
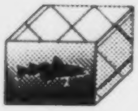
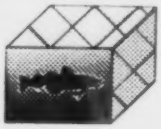
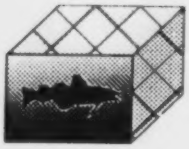


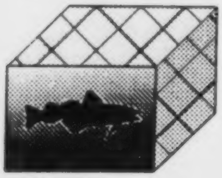
Newfoundland Mobile Gear Selectivity Workshop (1992)



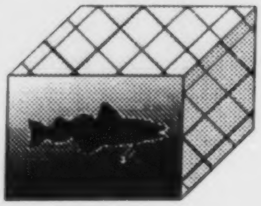


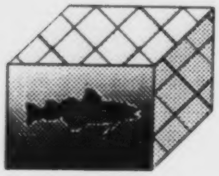
Technical Report

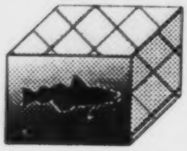


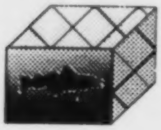


St. John's, Newfoundland
April 27-28, 1992









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INTRODUCTION

The purpose of the April, 1992 Newfoundland Mobile Gear Selectivity Workshop was to conduct an exchange of technical information and to hold an industry consultation on selectivity (sorting) experiments being conducted in Eastern Canada and Western Europe.

Technological development in the past has greatly increased productivity and efficiency in the fishing industry. Now, with the status of many species, particularly groundfish, in question, we must turn our attention to lessening the pressure on traditional stocks. One obvious way is to improve what are known as the "selectivity characteristics" of fishing gear being used by the industry.

Selective gear is designed to reduce: 1) the incidental capture of non-target species; and 2) the incidental capture of immature fish - especially cod, haddock and pollock - i.e., to exclude, protect or automatically release them during harvesting operations.

The Department of Fisheries and Oceans (Fisheries Operations Directorate) is proceeding on the basis of full consultation with all interested parties, particularly fishermen and processors. It has been involved in a number of gear selectivity research projects during the last few years which may change many of the ways we have been doing things in the fishery.

Data from these experiments will be used to:

- continue to inform the consultative process;
- help fishermen adjust to changing circumstances;
- prove/disprove current notions re selectivity and its impact(s) on fish stocks;
- develop fishery management plans; and
- determine, in consultation with the industry, the course of future work to be conducted in this area.

The use of more selective gear, is not only environmentally responsible, it is economically beneficial:

- improved gear selectivity can mean greater efficiency, improved yield and reduced costs for fishermen and/or processors; and

- a reduction in, or the end of, the discard of immature fish and non-target species can generate revenue and assist in the conservation effort.

In an effort to maintain the positive momentum, the Department worked directly with industry to deliver the Mobile Gear Selectivity Workshop to a broad cross-section of industry/government delegates. Much interesting work is being done in this area, and the results ought to be made available to as large a constituency as possible.

With this in mind, DFO is publishing and distributing this complete report of all technical presentations delivered at the Workshop. We trust it will serve as an important reference document for those interested in the many new developments taking place in fishing gear selectivity.

CANADIAN FISH CAPTURE SELECTIVITY PROGRAM

By

Andrew Duthie
Chief, Fisheries Technology
Fishing Industry Services Branch
DFO, Ottawa

CANADIAN FISH CAPTURE SELECTIVITY PROGRAM

By: Andrew Duthie
Chief, Fisheries Technology
Fishing Industry Services Branch
Department of Fisheries and Oceans
Ottawa

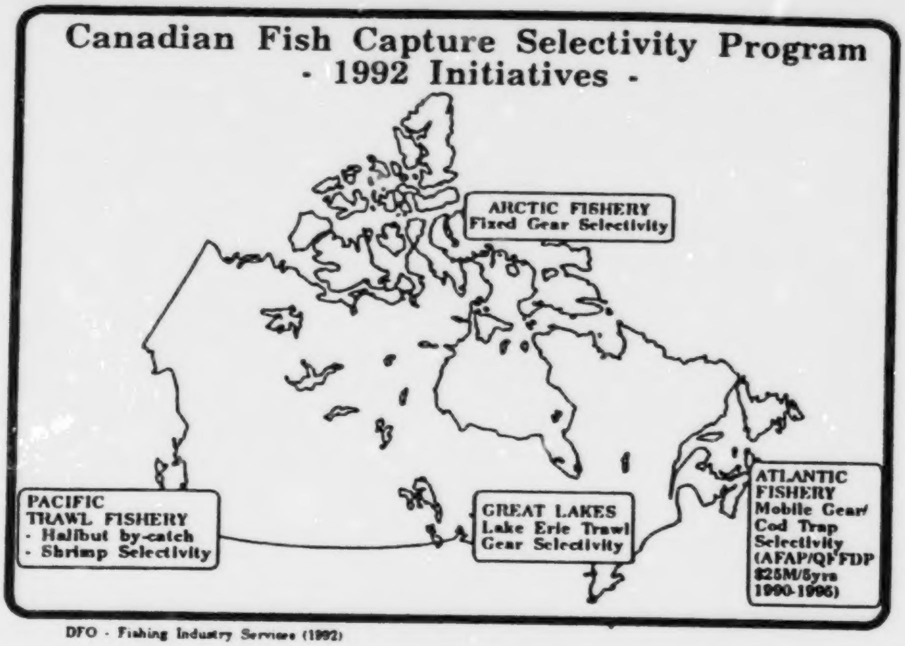
BACKGROUND:

The Canadian fish capture selectivity program, which is national in scope, provides a direct link between the Pacific, fresh water and Atlantic fisheries. This program is oriented at improving the efficiency, profitability and competitiveness of commercial fishing operations without further expanding capacity, and is an essential component of sustainable fisheries development.

CURRENT STATUS:

As a result of the current serious resource problems within Canada, fishing gear selectivity initiatives designed to allow for the escapement of immature fish and non-target species have been identified as an area of high priority within the fishing industry.

In order to provide solutions to these problems a series of initiatives are being conducted in 1992 by the Department of Fisheries and Oceans, in partnership with the Canadian fishing industry and related provincial government agencies, in the Pacific, the Great Lakes, the Arctic and in eastern Canada.


Canadian Fish Capture Selectivity Program
- 1992 Initiatives -
ARCTIC FISHERY
Fixed Gear Selectivity
PACIFIC
TRAWL FISHERY
- Halibut by-catch
- Shrimp Selectivity
GREAT LAKES
Lake Erie Trawl
Gear Selectivity
ATLANTIC
FISHERY
Mobile Gear/
Cod Trap
Selectivity
(AFAP/QFFDP
$25M/5yrs
1990-1995)

DFO - Fishing Industry Services (1992)

These initiatives include the design, development, demonstration and application of selective, cost-efficient and environmentally friendly fishing gears. Emphasis is placed for the work to be carried out on commercial fishing vessels, where possible, in cooperation with fishermen, and in full partnership with the Canadian fishing industry.

INDUSTRY CONSULTATIONS:

Within the Canadian fishing community a large number of fishermen are actively involved in fishing gear selectivity work. However, there are only eight to ten fisheries technologists in Canada who are directly involved in R&D and technology transfer to industry in this area. Workshops such as the ones in St. John's and Halifax are used as a means to encourage direct consultation with the fishermen and the fishing industry.

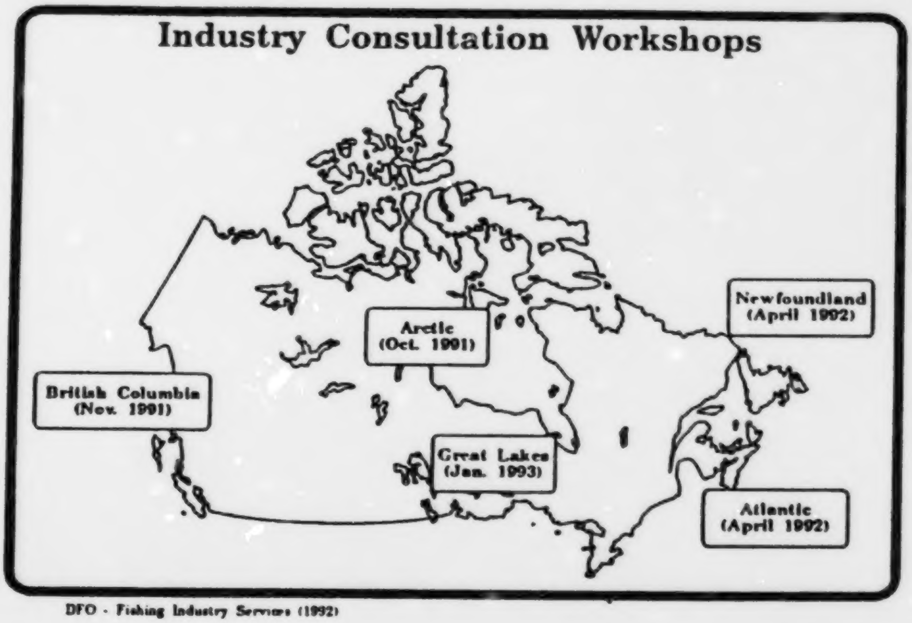
In the Arctic, the Department of Fisheries and Oceans conducted a technical consultation with fishermen from the Northwest Territories and Labrador in October, 1992, where the issue of selectivity and fixed gear was addressed.

In British Columbia, in November, 1991 a gear selectivity workshop was conducted with B.C. Trawl skippers in partnership with the Deep Sea Trawlers' Association of B.C. and the Provincial Government of British Columbia.

In Newfoundland, in April 1992, a mobile gear workshop was conducted in conjunction with Fishery Products International Ltd., where trawl skippers from Newfoundland, British Columbia and the Great Lakes participated.

This workshop is being conducted in partnership with the Seafood Producers' Association of Nova Scotia and the Nova Scotia Department of Fisheries.

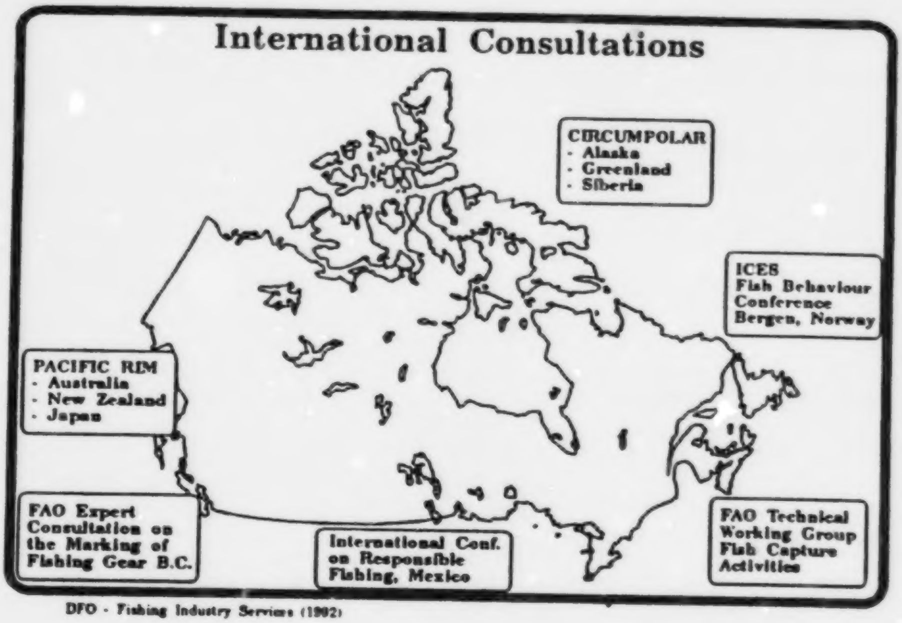
Later in 1992, a technical consultation with fishermen will take place with the Ontario Fish Producers' Association and the Ontario Government.


Industry Consultation Workshops
Newfoundland (April 1992)
Arctic (Oct. 1991)
British Columbia (Nov. 1991)
Great Lakes (Jan. 1993)
Atlantic (April 1992)

DFO - Fishing Industry Services (1992)

INTERNATIONAL CONSULTATIONS:

In Canada, the number of fishing gear specialists within the fishing community is small, and the same situation applies within international community. A number of our colleagues from ICES and the FAO are also working on gear selectivity. It is essential that we continue the dialogue of technical information exchange with our colleagues worldwide. This will result in a great deal of beneficial effects to the fishing industry and reduce overlap and duplication of effort.


International Consultations
CIRCUMPOLAR
- Alaska
- Greenland
- Siberia
ICES
Fish Behaviour
Conference
Bergen, Norway
PACIFIC RIM
- Australia
- New Zealand
- Japan
FAO Expert
Consultation on
the Marking of
Fishing Gear B.C.
International Conf.
on Responsible
Fishing, Mexico
FAO Technical
Working Group
Fish Capture
Activities

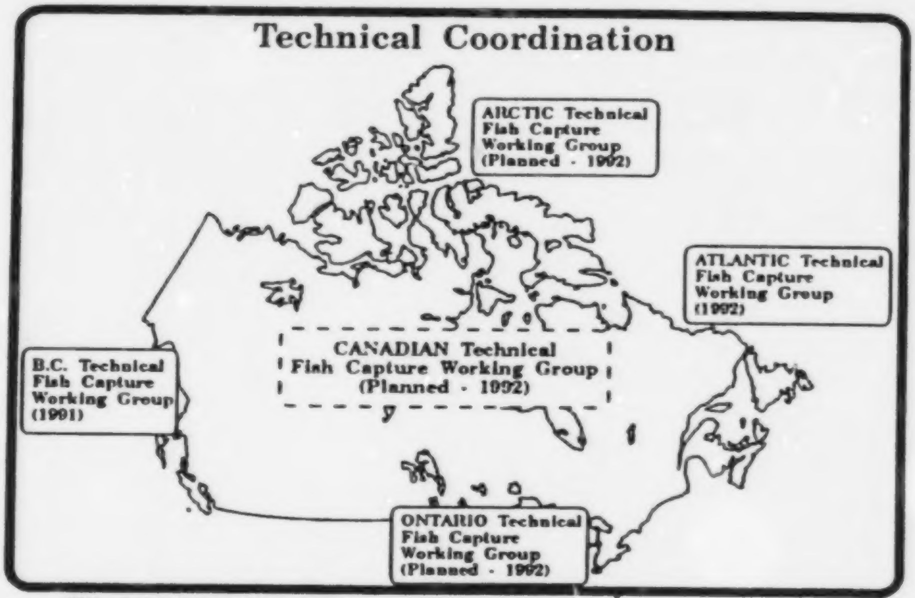
DFO - Fishing Industry Services (1992)

The Department of Fisheries and Oceans is involved in a number of international consultation activities. In July, 1991, in conjunction with the FAO, an Expert Consultation on the Marking of Fishing Gear was held which led to a series of technical working group consultations this year in Rome. This led to the preparation of a paper on "Fish Capture Activities" which will be addressed at the International Conference on Responsible Fishing, which will take place in Mexico in May, 1992.

This conference, which will be attended by representtives from 66 countries, will look at fishing gear selectivity on an international scale.

Representatives from the Department will also attend the ICES Fish Behaviour Conference in Bergen, Norway, in June 1992.

TECHNICAL COORDINATION:


Technical Coordination
ARCTIC Technical Fish Capture Working Group (Planned - 1992)
ATLANTIC Technical Fish Capture Working Group (1992)
CANADIAN Technical Fish Capture Working Group (Planned - 1992)
B.C. Technical Fish Capture Working Group (1991)
ONTARIO Technical Fish Capture Working Group (Planned - 1992)

DFO - Fishing Industry Services (1992)

In 1991, in British Columbia, a Technical Fish Capture Working Group was established. This group was established by the Deep Sea Trawlers' Association of B.C., in partnership with the Department of Fisheries and Oceans and the Government of British Columbia.

In the Atlantic, the establishment of an Atlantic Technical Fish Capture Working group is in process. Members of this group will consist of a DFO gear specialist from each of the four Atlantic regions and Headquarters with direct participation from the fishing industry.

Later this year, two technical working groups will be also be established. The first with the Ontario Fish Producers' Association and the Ontario government, to look at gear selectivity within the freshwater area. The second will be established in the Arctic with fishermen groups, and in association with the Territorial Government.

In 1993, it is projected that a Canadian Technical Fish Capture Working group will be established to provide a national focus on fishing gear selectivity activities.

TECHNICAL HARVESTING ASSESSMENT STUDY:

The Department of Fisheries and Oceans has contracted a Montreal firm to undertake a study leading to the identification of technical harvesting assessment opportunities, looking at all gear types in Canada. The company Poupart, DeBlois Ltd. has formed a team of technical specialists from the Pacific, Freshwater, the Great Lakes, the Gulf of St. Lawrence, the Atlantic and the Arctic. The results of this exercise will be presented to an industry forum later this year.

Technical Harvesting Assessment Study
ARCTIC
PACIFIC
Freshwater Lakes
Great Lakes
Gulf of St.Lawrence
ATLANTIC

DFO - Fishing Industry Services (1992)

CANADIAN GEAR SELECTIVITY ACTIVITIES:

In 1992, the Department of Fisheries and Oceans, in partnership with the fishing industry will conduct a number of initiatives.

— In British Columbia, two experiments will be conducted on commercial fishing vessels in conjunction with the Deep Sea Trawlers' Association and the Government of British Columbia to look at halibut by-catch and shrimp selectivity.

— In the Great Lakes area, gear selectivity experiments will be carried out on commercial fishing vessels in partnership with the Ontario Fish Producers' Association and the Ontario Government.

— In the Arctic, selectivity work will take place in cooperation with fishermen and the Government of the Northwest Territories

— In the Atlantic, a considerable amount of gear selectivity work has been undertaken over the past eight years. Two Federal Government programs, the Atlantic Fisheries adjustment Program and the Quebec Federal Fisheries Development Program provide funds to conduct work in this area. An estimated total of $25 million has been allocated for selectivity work over the next five years.

CONCLUSION:

The Department of Fisheries and Oceans, Fishing Industry Services Branch will put increased emphasis on a **partnership role** with fishermen and the industry.

The Minister, the Hon. John C. Crosbie has given very clear instructions: "... we must work closer with the industry, in cooperation with the industry...". This is the approach we are now taking regarding current and future fishing gear selectivity work in Canada.

CANADIAN
FISH CAPTURE SELECTIVITY PROGRAM

By: Andrew Duthie
Chief,
Fisheries Technology

DFO - Fishing Industry Services (1992)

CANADIAN
FISH CAPTURE SELECTIVITY PROGRAM
- INTRODUCTION -

The Canadian Fish Capture Selectivity Program, within the Department of Fisheries and Oceans (DFO) is national in scope and provides a direct link between the Pacific, Freshwater, Arctic and Atlantic fisheries. It is oriented to improving the efficiency, profitability and competitiveness of Commercial Fishing Operations without further expanding capacity and is an essential component of Sustainable Fisheries Development.

As a result of the current serious resource problems within Canada, fishing gear selectivity initiatives designed to allow for the escapement of immature fish and non-target species has been identified as an area of high priority within the fishing industry.

In order to provide solutions to these problems, a series of initiatives will be conducted in 1992 by the DFO in partnership with the Fishing Industry and related Provincial Government Agencies, in the Pacific, the Great Lakes, the Arctic and eastern Canada.

This will include the design, development, demonstration and application of selective, cost-efficient and environmentally friendly fishing gears. Emphasis will be placed on the work being carried out on commercial fishing vessels in cooperation with fishermen.

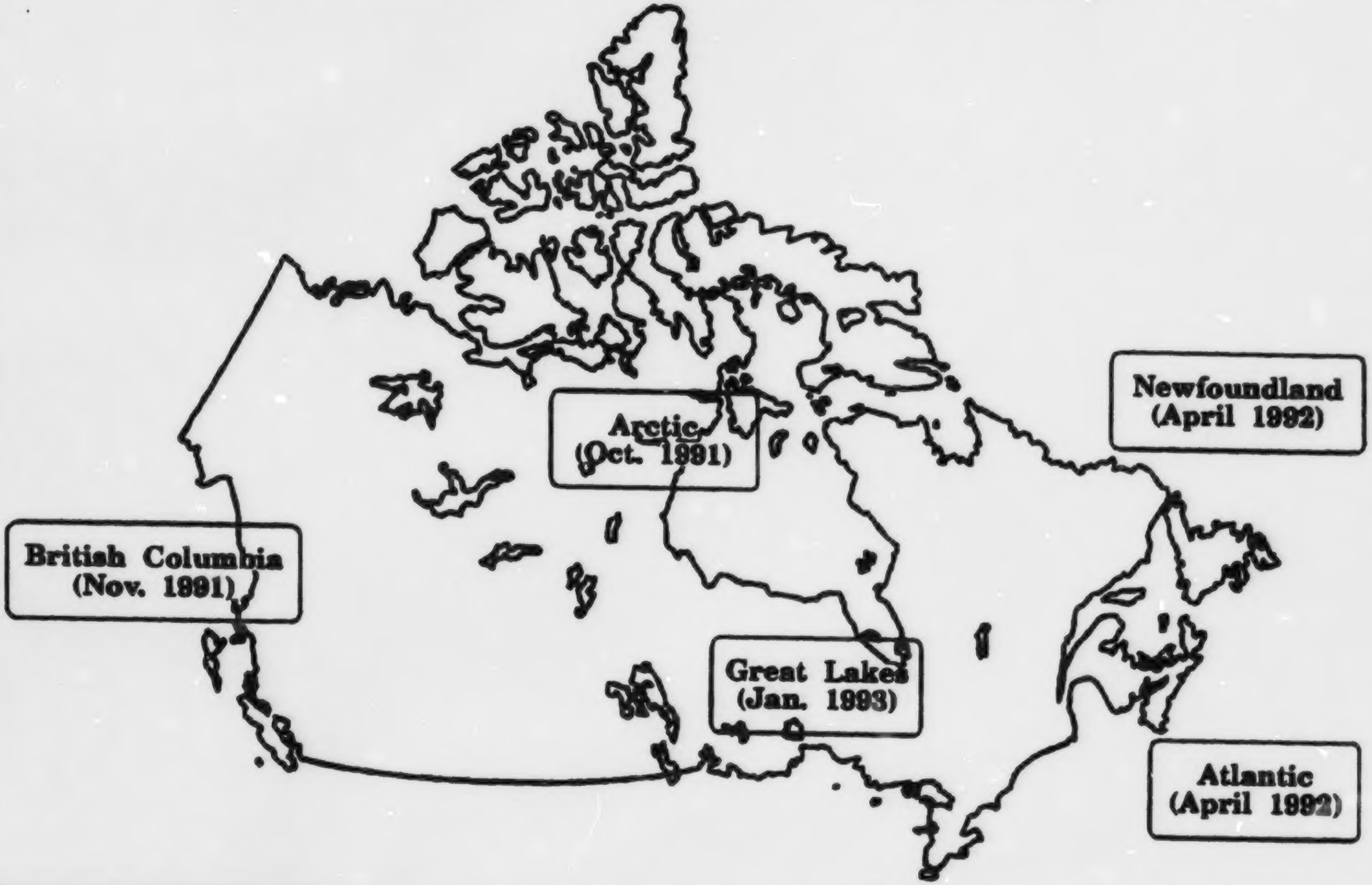
CANADIAN FISH CAPTURE SELECTIVITY PROGRAM

INTRODUCTION

- National in scope - Pacific, Freshwater, Arctic and Atlantic
- Gear Selectivity work considered a priority to provide solutions to resource problems
- Initiatives designed for escapement of immature fish and non-target species
- Conducted in partnership with industry on commercial fishing vessels

DFO - Fishing Industry Services (1992)

CANADIAN FISH CAPTURE SELECTIVITY
Industry Consultation Workshops


Newfoundland (April 1992)
Arctic (Oct. 1991)
British Columbia (Nov. 1991)
Great Lakes (Jan. 1993)
Atlantic (April 1992)

DFO - Fishing Industry Services (1992)

FISH CAPTURE SELECTIVITY
International Consultations

CIRCUMPOLAR
- Alaska
- Greenland
- Siberia

ICES
Fish Behaviour
Conference
Bergen

PACIFIC RIM
- Australia
- New Zealand
- Japan

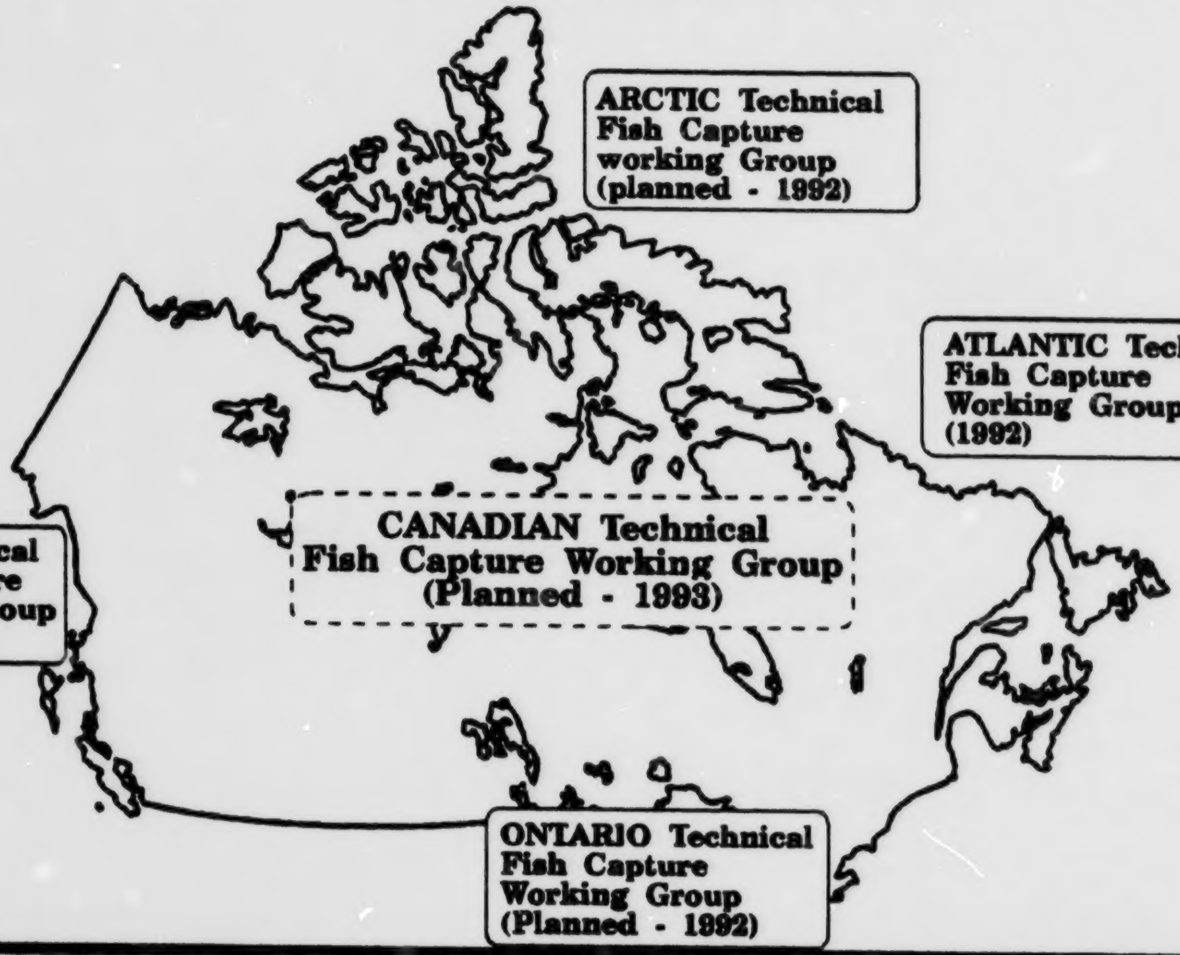
FAO Technical
Working Group
Fish Capture
Activities

FAO Expert
Consultation on
the Marking of
Fishing Gear B.C.

International Conf.
on Responsible
Fishing (MEXICO)

DFO - Fishing Industry Services (1992)

CANADIAN FISH CAPTURE SELECTIVITY
Technical Coordination



ARCTIC Technical
Fish Capture
working Group
(planned - 1992)

ATLANTIC Technical
Fish Capture
Working Group
(1992)

B.C. Technical
Fish Capture
Working Group
(1991)

CANADIAN Technical
Fish Capture Working Group
(Planned - 1993)

ONTARIO Technical
Fish Capture
Working Group
(Planned - 1992)

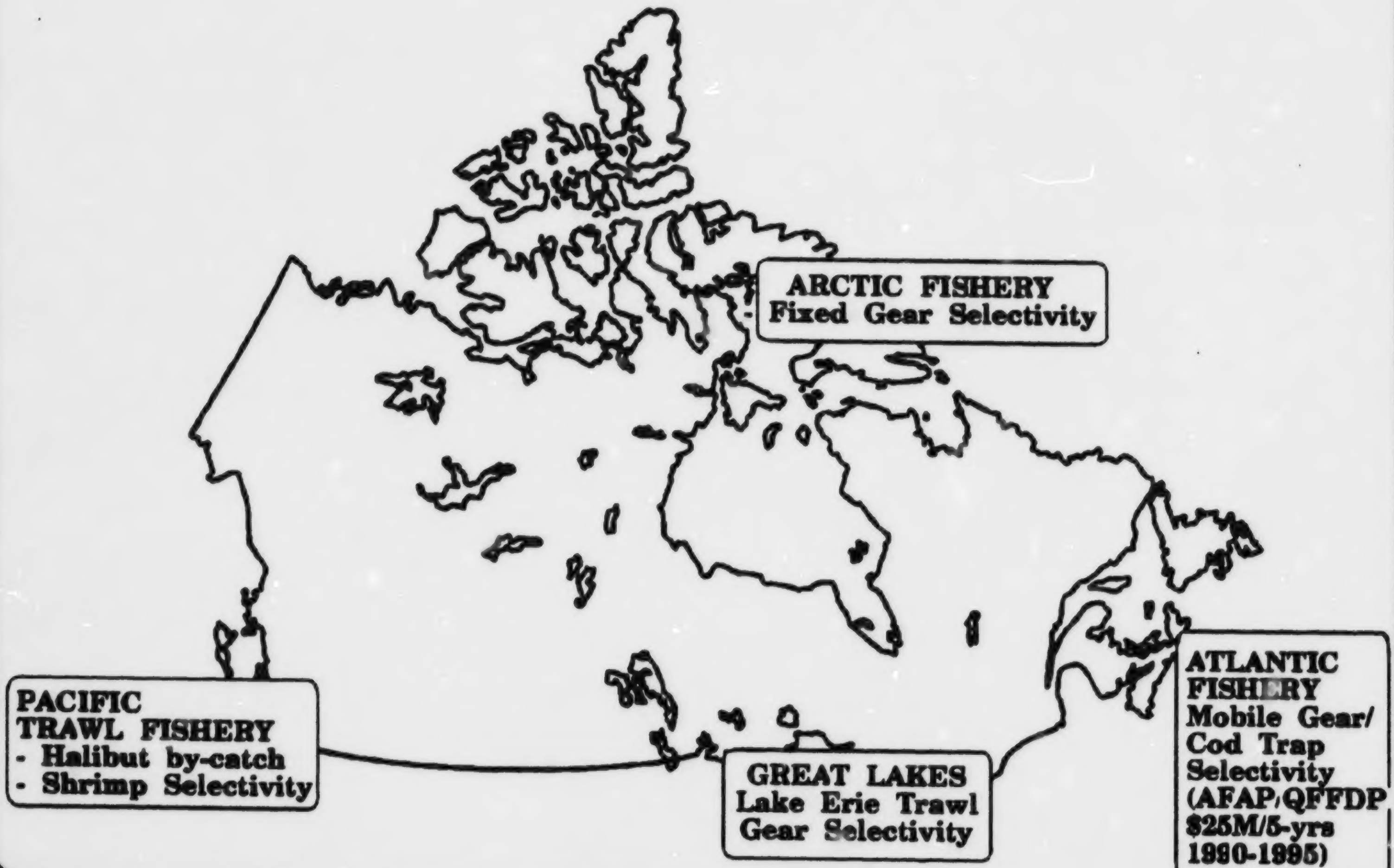
DFO - Fishing Industry Services (1992)

CANADIAN FISH CAPTURE SELECTIVITY
Technical Harvesting Assessment Study

ARCTIC
PACIFIC
Gulf of St.Lawrence
Freshwater Lakes
Great Lakes
ATLANTIC

DFO - Fishing Industry Services (1992)

CANADIAN FISH CAPTURE SELECTIVITY PROGRAM
- 1992 INITIATIVES -



ARCTIC FISHERY
Fixed Gear Selectivity

PACIFIC
TRAWL FISHERY
- Halibut by-catch
- Shrimp Selectivity

GREAT LAKES
Lake Erie Trawl
Gear Selectivity

ATLANTIC
FISHERY
Mobile Gear/
Cod Trap
Selectivity
(AFAP/QFFDP
$25M/5-yrs
1990-1995)

DFO - Fishing Industry Services (1992)

CANADIAN FISH CAPTURE SELECTIVITY
Detailed Mobile Gear Presentations

NEWFOUNDLAND

- Short Lacestage Ropes
- SORT-X System
- Square vs. Diamond Mesh

Gerry Brothers (DFO)
and
Ray Bowering (FPI)

SCOTIA-FUNDY

- Horizontal Panels
- Nordmore Grates

Chris Cooper (DFO)
and
Industry Representative

GULF OF ST.LAWRENCE

- Mesh Size Assessment
- Split Panel Trawl

Marcel Boudreau (DFO)
and
Industry Representative

FLUME TANK (Demonstration of models)

- Shrimp by-Catch Reduction Trawl

David Tait (SCANTEC)

DFO - Fishing Industry Services (1992)

OVERVIEW OF
INTERNATIONAL GEAR SELECTIVITY

FROM A FOOD AND AGRICULTURE ORGANIZATION PERSPECTIVE

By

John Fitzpatrick
Chief
Fishing Technology Services
Fishery Industries Division, FAO

OVERVIEW OF INTERNATIONAL GEAR SELECTIVITY FROM A FOOD AND AGRICULTURE ORGANIZATION PERSPECTIVE

Mr. Chairman, I have been reminded that the audience is one of fishermen and it may be pertinent, to recall that there are some 12.5 million fishermen throughout the world, all with different problems but all having to meet various rules and regulations. They harvested and landed around 85 million tons of fish in 1989. These fishermen operate from about 3 million fishing craft and from the beach and they deploy an incredible amount of fishing gear. The industry, world wide, is accused of over-investment in fishing vessels and this is often quoted as the main reason for overfishing and the threat to many stocks; what is important, however, is the sum of the fishing gear actually in use and how best to manage that gear.

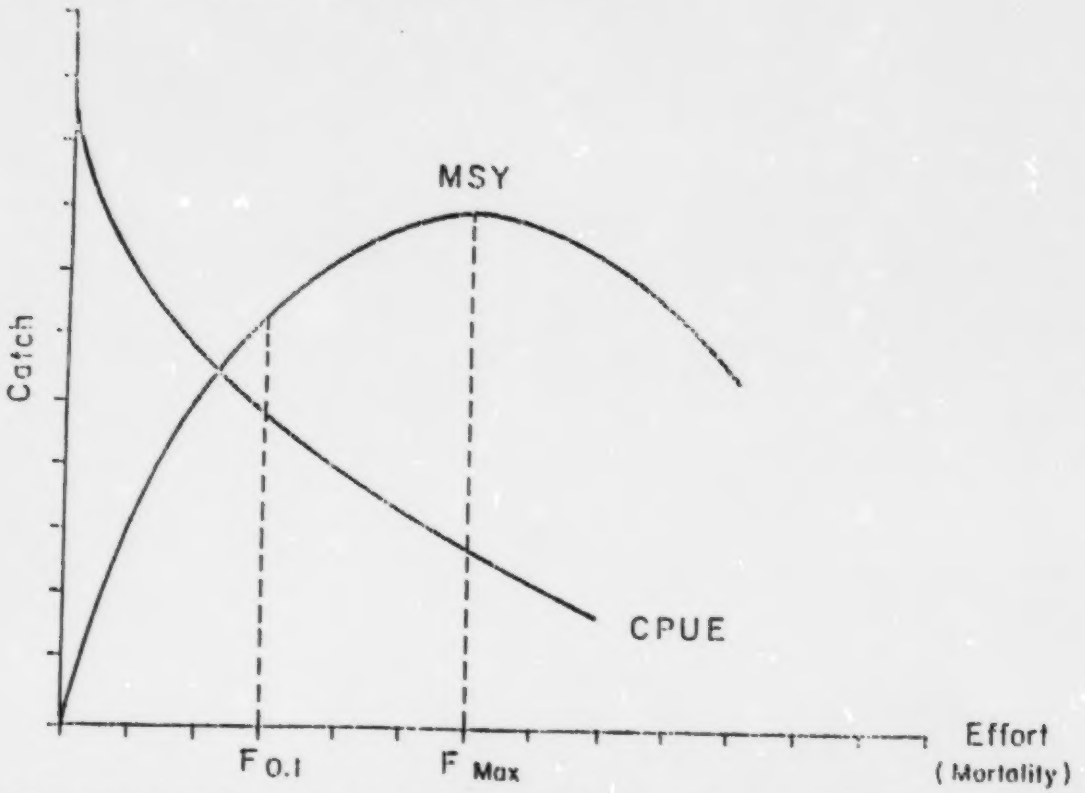
The sort of investment we are looking at in vessels and gear is a staggering amount if it is considered that if the whole fleet is to be rebuilt, the figure is nearly 330 billion US dollars. Naturally, the book value of this fleet is much less, probably less than two-thirds (but more than half) and even is we use the lower figure, there is still a great difference between capital utilized and the landed value of fish.

Furthermore, if we look at the operational costs and include a depreciation component, we would find:

i) total cost of operation: 90,00 million US dollars;
ii) total income from catch: 70,000 million US dollars;
iii) variance: 20,000 million US dollars

Well, someone seems to be in trouble!

Take another view, we then have the classic curve:



Clearly the level of effort should be to the left of F Max but from the analysis mentioned above, the effort line is currently well to the right-hand side of the graph.

What do we do with the excess fleet capacity and how do we control the "sum of the gear" in use?

The answers would vary and perhaps this is not the time to go into detail, although some questions might be raised during discussion time.

Apart from overfishing, for whatever reason, the living resources of the seas are under threat from the effects of pollution of the marine environment; this is not an idle threat, the Black Sea is the most recent example with catches dropping from 900,000 tons in 1980 to 100,000 tons in 1990. We know that the main source of marine pollution comes from land use, industrial estates and urban areas, and we know that there is a common belief that if waste, including dangerous substances, is dumped in deep water, the problem is swept under the carpet and there is no "feedback". We also know that it would take time and an incredible amount of money to stop pollution from land and industrial sources.

Until massive action is taken, pollution will continue, fish will suffer, as will dolphins and seals, and by no means least, the fishermen will suffer. Yet, the fishermen are held responsible with regard to "Responsible Fishing" and fisheries are being closed down through the political lobby of Green movements even though unlike those who dump hazardous wastes in the sea, the fisherman does get a "feedback" with respect to his activities. In addition, and it happens in other parts of the world, poor information or resources often leads to the wrong management decision.

As far back as 1965, there were many experiments to increase the efficiency of trawls. In one such experiment, a set of gear was actually developed with the cooperation of Saunders-Rose in the UK, and they were, in fact, designers of aeroplanes. The results showed little difference in the catch rates, even though the "Saunders-Rose" trawl had a bigger opening than the more commercial trawl used in the experiment. The conclusion was that it appeared that other parts of the gear had an influence on fishing efficiency. That was 27 years ago and yet I still read that not enough is known about the effect of "other parts" of the gear.

There is also the behaviour of fish to fishing gear to be considered and this becomes more complicated in the case of multi-species fisheries. Perhaps this is one of the reasons that most of the research into fishing gear selectivity has been carried out by developed countries in the higher latitudes. The benefits accrue to such fisheries and, unfortunately, the technologies are generally not readily transferable to the tropics.

The International Council for the Exploration of the Seas (ICES) will hold a major meeting on fish behaviour in June of this year and the results will be of great importance, not only to the participating countries, but to all interested in applying more responsible fishing regimes, and to enable them to address more effectively the ways in which selectivity can be achieved, i.e.:

i) choice of fishing ground;
ii) choice of fishing method;
iii) determination of fishing gear parameters;
iv) the way in which the gear is rigged (an individual approach);
v) deployment of the gear.

FAO is, of course, looking forward to the outcome of the ICES meeting. We have, for example, to participate in an International Conference on Responsible Fishing to be held in Cancun, Mexico, next week, and in September of this year, we convene a Technical Consultation on High Seas Fishing (which will be held in Rome). In both instances, the state of the art with respect to the degree of selectivity of fishing gears and methods will come under scrutiny and there will certainly be a call for further improvement.

However, in June, the critical United Nations Conference on Environment and Development (UNCED) may well cause dramatic changes in how fisheries are managed and prosecuted. The lobby of the environmentalists will be strengthened and we are likely to see greater pressure on commercial fisheries from sport fisheries, tourism, and through new requirements for international trade.

The environment and trade issues are already causing concern to exporters of shrimp and tuna. Fishing gears and methods under the microscope are trawls, purse seines and large pelagic driftnet. The latter is, of course, the subject of a UN moratorium motivated by the fears of certain coastal States that high seas fishing would affect their own traditional tuna fishery, but pressed home by the environmentalists with claims of catches of dolphins, turtles and sea birds. Purse seine operations for tuna, particularly east central Pacific, have been forced to develop techniques to allow the escape of dolphins and to introduce an extensive (and expensive) observer programme. The techniques, however, are not "fail safe" and there are times when a combination of weather, vessel performance and how the skipper feels, leads to above average catches of dolphin; this is enough to keep up the pressure from Green movements which claim "that if a dolphin is molested during a fishing operation, that method should be banned".

In some areas of the world, the sportsmen's lobby is very powerful indeed. We have seen the effect in southern California with legislation prohibiting commercial fishing operations. Some small island States have adopted similar practices to enhance their tourist industry at the expense of the commercial fishermen. In these cases, the fishermen often suffer hardship through lack of alternative job opportunities, and in many cases the social services are not attractive. Selective fishing gear is not necessarily the answer to such problems since the root cause is a combination of fishing gear interaction and competition for target species.

FAO has been directly involved in most cases, either through our field project activities or through joint research programmes with institutions in member countries, and our work has been linked to the wider issues of under-utilized species, reduction of by-catch, and alternative technology to traditional methods.

Mid-water trawling is an example, particularly for meso-pelagics and for tuna. In the case of meso-pelagics, the very long wings, with very large mesh (up to 1.6 m stretched) and at a low towing speed (about 2 knots), have a herding effect and this was noted through the use of underwater cameras.

This herding effect was also seen to be important in pair trawling for albacore by the French. The behaviour of the fish being one of surprise on entering the fore part of the net. Their first reaction was to shoot upwards to the surface only to encounter the closer mesh of the net, then dive, with the same effect, and finally to "flee", the wrong way, towards the cod end. Good catches have been recorded and although there is some damage to individual fish, it seems the short trips gave some guarantee of freshness and reasonable prices were obtained.

However, although the motivation to move to mid-water trawling was more for reasons of efficiency, it was noted that the selectivity improved as a consequence of the "method" in that marine mammals were not caught, mainly due to the operational depths being below the "Dolphin" layer.

Shrimp Trawls

Perhaps our activities at FAO on gear selectivity have been more concerned with the exclusion of turtles and the reduction of the by-catch in shrimp trawling in tropical areas. The development of the Turtle Exclusion Device (TED) has a fairly long history and its acceptance by the fishermen, not very enthusiastic due to plummeting efficiency with respect to the target species; its mandatory introduction, however, is another matter. The experience in the USA was certainly traumatic with severe conflict between the authorities and the fishermen, but, and this is important, the authorities had the sympathy of the public.

Fortunately, the technologists concerned finally brought the fishermen into the development process and as a result a number of new approved designs have come on to the market.

The reduction of by-catch has not had any great success if the claims of up to 5 million tons of discards each year are correct, although there has been some improvement in the temperate latitudes with the Norwegians and Danes claiming good results. However, this is not the case in the tropics and the loss of efficiency is still considered to be too great.

The importance of these issues led to FAO convening an Expert Consultation on TED's and BED's in 1986 in Mexico. Later, at the World Symposium on Fishing Gear and Fishing Vessel Design, St. John's, 1988, a workshop was held and rigs were demonstrated in the flume tank. More has yet to be done and FAO will pursue these issues; so will many administrations, since trade restrictions are being imposed by some importing countries - if you do not use a TED, we won't buy your shrimp.

Mesh Shape

The common approach to selectivity is, of course, mesh size, and fishing regulations invariably set the minimum mesh size for codends. However, with the interest in the shape of the mesh, some of you will recall that in conjunction with the St. John's Symposium mentioned earlier, a workshop on square mesh was also held. Here, on the eastern coast, you probably have more experience than any other part of the world. Indeed, Scanmar's head office has no record of their catch sensors being used on codends with square mesh; I was asked to find out from David Tait.

Our own experience is rather limited, although it is clear that maintaining the mesh shape in the codend throughout the period of the tow is important. Some success in preventing distortion has been achieved through the use of ropes along the length of the codend to take the strain.

In general, there remains some doubt about the real survival rate of the fish that escape. It seems to be pertinent that damage sustained in the escaping process does have an effect on the mortality levels after escape but this also varies according to species, some being more robust than others. Such uncertainty does not help the "fisheries" case vis-à-vis the Green Movement, if the escapes fall into the category of endangered species; this being quite a possibility in tropical areas.

Perhaps Mr. Robertson could bring us up to date regarding the experience in his area, particularly in view of the intention to increase the minimum mesh size to 100 mm.

Implementing Changes

This mention of increasing the mesh size brings me to the question of implementing changes in fishing gear designs and fishing methods. I mentioned earlier the problem of TED's which was not only technical, not only reducing efficiency, but also a costly change. Obviously with towed gear, if only the codend of a trawl is changed (through an increase in mesh size), the costs may not be prohibitive to the industrial fishing industry but if the gear as a whole has to be changed, it would be a completely different matter. Similarly, if a gear is banned, the industry changes to another method often at a significant cost. This happened in Indonesia; trawling was banned, fishing continued, albeit after a slow start, with new gear and the catch (and species composition) reached the same levels as before the ban on trawling.

If we look at the industry as a whole, fishing vessels over 100 GRT represent only about 1 percent of all the fishing craft in the world. In fact, looking at the various categories, we have:

Size	Number of Vessels
> 1000 GRT	3,010
500 - 1000 GRT	2,100
100 - 500 GRT	30,600
< 100 GRT (decked)	1,100,000
< 100 GRT (undecked)	2,100,000
TOTAL	3,235,710

It is an enormous task for the net-making industry (maybe lucrative) if sweeping changes are to be forced on the fishing industry as a result of external pressures.

It is also an enormous task for fisheries management to cope with but the outcome of the age of the environment may also cause the industry to be trimmed to bring the investment in fishing effort (worldwide) more in line with what is, after all, a finite resource.

I look with interest at "Project 2000", implemented by Denmark to provide the means to harvest quality fish in a sustainable manner at an acceptable cost in the next century.

But I wonder how well the industry can get the principle of sustainability acknowledged as it relates to harvesting as a source of food to man, rather than a biological resource. If it does not, it may well be on the receiving end of unpalatable management measures brought about by an over cautious use of precautionary principles.

Drifting Gill Nets

The experience in dealing with the issues on the high seas mentioned earlier will certainly have an impact on the design of gear used within EEZ's. The so-called Wellington Convention limits the length to a maximum of 2500 metres. That will not suit fishermen in other parts of the world where even the small scale fishermen are using gear of up to 10,000 metres on widely dispersed stocks. Almost certainly this gear will come under scrutiny and more work needs to be done to improve the selectivity of the METHOD while retaining an acceptable measure of efficiency.

Some success has been obtained by setting the gear up to about 10 metres below the surface to reduce the incidental catch of cetaceans and sonic devices have been used to warn the dolphin of the presence of a net. However, it may also be necessary to consider increasing the density of at least strategic parts of the netting to reflect sonic signals but at the same time retaining the physical invisibility to the target species; this obviously needs some development work since the degree of light refraction usually increase with an increase in material density.

There is, of course, the problem of birds and turtles and each has a different level of priority according to where the fishing activity takes place. For example, in New Zealand waters, the incidental catch of a type of albatross is threatening the closure of a trawl fishery and in Antarctica, longliners were accused of being a real threat to the existence of the albatross itself. The latter problem may now be solved through the use of gear depressors introduced by the industry but the secretariat for the Antarctic Convention fears that excessive damage has already been done.

Still in the southern hemisphere, the Australians have developed an "environmentally friendly" trawl. This is claimed to take less benthos and trash fish without a loss of efficiency in relation to the target species. In effect, it does the opposite to the Granton trawl in that the foot rope does not really touch the ground and the strain of the tow is taken by the upper part of the net. Incidentally, this gear was developed by an ex-colleague of mine at FAO and it is known as the "Julia Ann" after his wife.

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES) PERSPECTIVE

OVERVIEW OF INTERNATIONAL GEAR SELECTIVITY INITIATIVES

By

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OVERVIEW OF INTERNATIONAL GEAR SELECTIVITY INITIATIVES

Scientific opinion in the middle of the last century suggested that stocks of fish were inexhaustible. Apparently you could catch as much as you wanted and there would still be lots of fish left in the sea. It was an incredible idea and one that worried many people in the scientific community.

In the middle of the last century the mobile gear fishery developed quite dramatically, in the north sea in particular and off the Canadian and American eastern seaboard. It was at that time that the whole idea of the inexhaustibility of the stocks began to worry many of the scientists both in Canada and America and in Europe, mobile fishing gears were destroying huge amounts of the juvenile fish. The question became, how can the stock remain viable if so many of the juveniles are being destroyed. Nobody new the answer. The scientists individually got together and decided that they would create a body of expertise and they set up ICES in 1902. ICES stands for the international council for the exploration of the sea, and these gentlemen got together and they formed what they described as a council of members. And all of the countries principally bordering the north sea in Europe and later on some Canadian and Americans and other countries got involved. But initially, the council was set up with members from mainly the European countries. The council elected what they described as a bureau which had a president, a vice president and a general secretary and it was the bureau's job to administer the organization of the council. The council itself set up various committees which looked at individual aspects of the fishery. For example, the stock sizes, the hydrography of the seas, and many other committees that are too numerous to go into in detail here. But they set these committees up to advise and make recommendations about how much fish was in the sea. One immediate problem was the fact that overfishing was occurring. They felt very strongly that they needed to devise methods to save the juvenile fish and that's what some of those committees were set up to look at.

Through time, ICES has developed. More countries have joined. Each country puts money into it and it's a very large organization these days. But the whole idea is that it's not a regulatory body, it is simply an advisory body. It gathers scientific expertise and its scientists advise and make recommendations to the various countries that are involved in the organization. One point to remember is that from 1902 until quite recently, there wasn't a single fishermen or anyone from the fishing industry involved in ICES whatsoever. Nowadays that position is slowly changing.

The various ICES member countries around Europe have the responsibility of going out in research vessels to find out how many juvenile fish are in the sea and how big the stock is in the sea areas they investigate. The destruction of juvenile fish is still the main issue concerning us all in ICES and indeed all over the world. The discard level from the mobile gear fishery is quite enormous. For example in ICES IV area of the north sea, there has been a continuous reduction of catch levels from 1970 to 1990. In the mobile gear fishery with pair trawl, seine nets, otter trawls, prawn trawls, the discard levels of haddock are about one third of the total catch. It's quite incredible that in this small area of the world's oceans and seas, that that amount of fish is destroyed. Mobile gears are catching many juvenile fish and that's what this workshop is all about. It's about finding methods to save those young fish. We're looking at the methods that we're now using and in some cases, adopting to allow more of the juvenile fish to escape. Presently, the ICES committee on fishing technology and fish behaviour is investigating ways of allowing more juvenile fish to escape from mobile gears. It's this committee that is most concerned with the selectivity of fishing gear and the committee meets once a year. It's a very useful body of people who get together to exchange ideas on gear design and selectivity. Canada is part of that process and we swap ideas between Europe and Canada. ICES is concerned with:

1) the selectivity of prawn trawls
2) square mesh
3) other net constructions to improve selectivity

4) the methodology of how we measure what's happening in the gear
5) fish behaviour in the gears
6) and the survival of the escapees

In the case of the selectivity of the prawn trawls, we have in the north sea two mesh sizes. The prawn trawl catches prawns (nephrops norvegicus) which are rather like small lobsters. You don't have them here in the eastern part of Canada. They are red in colour, about six inches long on average and it's the tail part that's eaten. They burrow in the mud in the seabed and they come out to forage for food and they're caught at that stage with the trawl gear. But because the animals are so small, prawn trawls are allowed to use a smaller mesh size than the gears that catch haddock, cod and whiting. Prawn trawls use 70mm. There can be a high discard level of these juvenile prawns. Until recently, there was no quota in the north sea or to the west of scotland for prawns. But because of discard studies and the realization that so many were being destroyed, we are now in ICES experimenting with larger mesh sizes to let more juveniles escape. This is a very big concern for ICES at the moment in the European fishery.

The second issue is square mesh. ICES have been investigating square mesh now for some 12 years. Canada is deeply involved with square mesh as is America and the European countries. Square mesh is not new, probably by now everyone knows that square mesh was first used in 1895 by an english man called holt who realized the extent of the destruction of juvenile fish in trawl gear. He wanted to open the mesh up and let more juveniles escape. He tried square mesh and found that it let many more juveniles escape. But there were problems with it: strength is reduced, the knots in knotted netting can slip causing the mesh to close up and become ineffective. Square mesh was not taken up. Rather than having the whole cod end in square mesh, why not have what we call a window on the top side. This was first tried by gelder in 1928. It is particularly useful for haddock and whiting because as they travel down the length of the extension, their behaviour pattern tends to be upwards but they can't escape through the closed diamond mesh. When they come into the square mesh window region, escape rates are enhanced. The square mesh window is now in legislation in the UK and Europe.

The window is a very small part of the overall size of the trawl. It's only about a metre across by 3 metres long on the top side of the cod end or extension.

It's not enough simply to increase mesh size. Diamond mesh closes up, however big the mesh is. So we are now saying we must open the mesh in other ways and one other method is lastage ropes where the netting is hung on short ropes. The meshes are held more open and I know Canada is doing good experiments on that as have other European countries within the ICES community. Another method of opening the meshes is by reducing the number of meshes on the cod end circumference. If you reduce the meshes, they open wider to match the extension piece to which the cod end is joined and this case reduces the catch of juvenile fish as well. So those are a brief overview of the other net constructions to improve selectivity. Now I'd like to pass on to Roger to explain the rest of ICES's work on gear selectivity, methodology and fish behaviour.

The North Sea

The North Sea situation is bad. The stocks in the North Sea are reducing. There are high discards of young fish. We're destroying huge amounts of juvenile fish. It's got to stop. We've been doing a lot of work through ICES as I mentioned earlier and individual countries (in particular the U.K.) Bordering the north sea are doing a great deal of work to investigate more selective gears using various devices.

The North Sea is regulated by the European community. There are 13 countries bordering the north sea who are involved in this European community. The community operates or sets it regulations from its commission in brussels. Each of the countries involved in the fisheries does experiments on selectivity. Generally this information is passed to ICES. ICES sends details to ACFM (this is the Advisory Committee for Fisheries Management within ICES). The information that ACFM have is then passed on to the European commission via what we call the STCF (this is the Scientific and Technical Committee for Fisheries). This committee is composed of scientists from the European community countries. Now it's that committee which decides on mesh size regulations, quotas, all of the regulations in the fishery and they advise and recommend the European commission. The fisheries ministers then vote within the commission on the establishment of mesh size increases or technical measures for more selective fishing gears. The fishing industry are saying to us, don't increase the mesh size, let's look at new methodologies like square mesh or lastage ropes or other devices. The industry are saying to us, quite strongly, "don't introduce any new device which will lose us marketable fish". And the scientific community is being driven more by that commercial necessity. It's proper and right in my personal opinion that we must introduce devices which the industry agree with and they will use legally but will not lose them marketable fish on a haul by haul basis but will at the same time reduce the catch of juvenile fish.

Before we can introduce any new device into the fishery, we must first prove that it is either better than anything previously used or that it can reduce the catch of juvenile fish. There are various methodologies available which can be used to test new devices. For example, a widely used method is the small mesh cod end cover. The cover over the cod end catches all the fish which have escaped from the cod end.

My personal view is that we should scrap small mesh cod end covers. They do not work. They give inaccurate data. But more than that, they do not emulate the commercial situation and what we have to assess is the difference between the commercial net as it is used by the fishermen and our new device. Everything has to be exactly as is used commercially. That doesn't work with small mesh covers. The alternate haul method can be useful, but great care has to be taken. You tow on your first haul your test cod end and on your second haul you might tow your original cod end or you can use a small mesh cod end to catch the total fish population by comparing the catches between the two hauls you can by statistical means determine how much young fish has escaped from the cod end. It suffers greatly from the problem of different populations between the tows. You can get lucky sometimes, in some fishing areas where there's a thin spread of fish over the ground and it's like that continuously through time. So over a day, the fish population doesn't change much. But that's rare, very rare indeed. You get spots of fish in one haul, fewer fish in the next haul. So you're getting an inaccurate estimate. In my opinion, the alternate haul method is not a good method either. Recently we have been developing the divided trawl or so-called trouser trawl. The method was first used back in the 1930's. It can suffer from two problems: if one side of the ground gear is slightly lighter on the seabed than the other side, more flat fish will escape under this side than that side, so the catch is different in the cod end, so the selectivity is different between the cod ends, so you can't get an accurate estimate of how much has escaped. It is a big problem with this method. You in Canada have been doing some very good statistical work, through Steve Walsh and his colleagues where you have been exploring the idea that the 50/50 split between the two sides of the trawl can be tested statistically. The idea of this trawl is that the same number of fish go into both sides. You have to have that to get a fair assessment or comparison between a square mesh cod end on one side for example, and your normal cod end on the other side. So that's the premise. You have to get the same amount of fish going into both sides. But it doesn't always happen that way for various reasons and this new statistical methodology developed here in Canada can deal pretty well with this unequal split. And that's a good thing, but I still don't like the divided trawl itself simply because the trawl is not designed as the commercial net. And again, we've got the problem, it doesn't emulate the commercial gears. The fishermen come back to me and say well you did divided trawl work but it didn't really mean anything to us. We don't believe it because fish behaviour must be different in the mouth of the trawl because it's split, it's designed completely differently from the nets we use. And that's a perfectly valid point and I agree entirely with them. And that's why I use the twin trawl system. The premise here is the same as the divided trawl - that the same number of fish are going into both trawls. You can use a two-wire towing system or a three-wire system. Both are good, but you have to make sure that both nets have exactly the same wing end spread and headline height. You know, therefore, that probably the same amount of fish is going into each net. Forget about this methodology if you have a smaller wing end spread or headline height in one net. You have to rig the gear so that both nets are precisely similar. The next problem is that sometimes fewer fish go into one net than the other. Now that's where the Millar and Walsh methodology can help us tremendously in the statistical analysis of the comparison of the catches. And that is a major step forward. I emphasize that fact - this is a major step forward, both the Canadian initiative on the statistical analysis of the data and on the methodology of using the twin trawls. And again, I would say my personal opinion is that at least in the trawl fishery, we should pay more attention to the twin trawl methodology. I'm not saying that the alternate haul method or the divided trawl method or the small mesh cod end cover method do not have their place or part to play in selectivity experiments. In certain fisheries, they can work if great care is taken with them and the data is well analyzed. The fishermen were convinced because they were seeing that the gear wasn't altered in any way compared to the commercial situation with the twin trawl system. So there were no fiddles, no small mesh covers, no alternate tows on different populations of fish. It was as they fish commercially.

The other big issue within ICES and around the world, is the survival of the fish escaping from the nets. There's no point in introducing a new device if more fish will not survive. But it's nice to know that a new device like square mesh will create a higher survival level. Results between diamond and square mesh showed that more escapees from square mesh would survive. I'm not saying that square mesh is the answer. The survival rate will be higher if you open the mesh by whatever means. By short lastage ropes, by grids, by lots of different methods that we're all investigating. The important thing is that the mesh is opened and there is less damage done to the fish. And again, it really is a hugely important aspect of the work that we're doing. European countries are doing a lot of survival studies now. It's becoming an important issue and the European commission are asking us as a body within ICES and within individual countries to look more and more at the survival rates because what they need is the knowledge of the selectivity of the gear but more and more also to convince fishermen, to convince themselves and the community at large - they need to know that the fish will survive. And if they can say to the industry, more fish will survive, that's a very good argument for the introduction of a new device.

The United Kingdom Minister of Fisheries and the European fisheries ministry are working hard and effectively towards helping to improve the fishing industry by introducing more selective gears. The fishing industries of Europe are also working hard to this end. There is a better awareness by everyone working in and serving the industry that more selective gears are required.

Canada, in particular, has a very responsible attitude to the saving of young fish. I congratulate you on all the previous and present good work you are doing in this respect.

History will relate that as far as the mobile gear fishery is concerned that the 1980's and early 1990's saw a massive effort by these countries to preserve a way of life and the jobs of fishermen by saving young fish to enhance and preserve the fish stocks to feed the nations of the world. We must all continue to work hard to preserve the food of the seas.

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES) PERSPECTIVE

A SHORT HISTORY ON THE DEVELOPMENT OF THE SORT-X SYSTEM FOR SIZE SELECTIVITY OF FISH

By

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Abstract

A solid and fixed sorting grid in the upper aft section of the trawl has been tested as an alternative to mesh size regulations of trawl codends. Since the pilot test in October 1989, several experiments using commercial fishing vessels are made in the period March 1990 to March 1992, covering more than 100 days of experiments. Additional three (Norwegian) experiments will be carried out during this year.

Several factors have been studied during the test programmes, i.e., bardistances, sizes of the grids, angles of attack, materials, etc. Some observations are made to study fish behaviour and how the system works. All the tests are made on important fishing grounds in the Barents Sea. Selectivity data are achieved on the most important species, i.e., cod, haddock, saithe, redfish spp. and Greenland halibut.

To determine the size selection on fish, a small meshed cover is used to collect all escaping fish. To avoid biased data due the mesh selection in the (normal) codend behind the Sort-X system, the codend is blinded. Thus, a true picture of the effect by the sorting grid alone is revealed. The results show improved size selectivity compared to normal trawl codends, and more important there is no change in this size selectivity whether it is small or large catches or densities of fish per towing unit of time.

Areas of Fishing, Species and Regulations of Today

This presentation with the whitefish trawling in our northern areas, i.e., north of 64°N, where other regulations are used compared to fishing grounds further south (in the North Sea). Most of the trawl fishery is carried out in the Barents Sea, harvesting species like cod (Gadus morhua), haddock (Melanogrammus aeglefinus), saithe (Pollachius virens), redfish spp. (Sebastes mentella, Sebastes marinus) and Greenland halibut (Reinhardtius hippoglossoides). Apart from our whitefish trawling, we do have a large trawl fishery for deep sea shrimps (Pandalus borealis) and a purse seine fishery for capelin (Mallotus villosus). Since 1990 minimum landing sizes (total length) of the most important species caught in the areas north of 64°N, no matter fishing gear (or method) used, are:

SPECIES	MINIMUM LANDING SIZE, cm	MINIMUM LANDING SIZE, cm
Cod	47	18.5
Haddock	44	17.3
Saithe	40	15.7
Redfish*	none	none
Greenland Halibut**	proposed 45	(17.7)

** Redfish smaller than 30 cm (11.8") total length are difficult to process.*

*** Since 1992 no trawl fishery for Greenland halibut is allowed, due to dramatic decline of the stock!*

A number of paragraphs are used to regulate the selectivity of the trawl codends. There are rules about roundstraps, chafers, etc., but most important are the mesh size regulations for trawls. For the areas north of 64°N the mesh sizes allowed are:

GEAR	MATERIAL	MESH SIZE, mm	MESH SIZE, inches
Whitefish Trawls	Nylon (PA) or terylene (PES)	135	5.31"
Whitefish Trawls	Courlene (PE) or ulstron (PP)	145	5.71"
Danish Seine	PA or PES	125	4.92"
Danish Seine	PE or PP	135	5.31"
Shrimp Trawls*	PA or PES	35	1.38"

** Since 1992 all shrimp trawling inside the Norwegian 200 mile econ. zone should be done with fish/shrimp separator (the "Nordmõre-grid").*

Quotas and Trawl Fishery

Since 1976 most of the species available for trawls have been regulated through total quotas, and the total allowable catches (TAC) have in general dropped since they were introduced. During 1991, the lowest quotas on cod, haddock, saithe, etc. in history were presented to our fishermen. On a ICES proposed TAC, fish and catches in our waters are shared between: 1) a certain percentage to third countries; 2) equally between Russia (USSR) and Norway. Almost 100% of all whitefish caught by the Russians are taken by trawls, whilst in Norway trawlers are given a rather small share (25 - 30%) of the national quotas. The rest (70 - 75%) of our quotas are shared between different vessel groups and fishing methods, i.e., gillnets, longlines, handlines, Danish seines and purse seines.

The shares of total quotas given to trawlers have dropped during the last 15 years, causing dramatic problems for this fleet. The numbers of typical whitefish trawlers have been reduced, but still the capacity is far too high. Target species for our Barents Sea operating trawler fleet used to be cod and haddock, while species like Greenland halibut, redfish and saithe more or less were regarded as (low-value) bycatch. Today, cod and haddock are taken as bycatch due to extreme low quotas for these vessels. As a result, more pressure is put on species like Greenland halibut, redfish and saithe. Since 1992 no trawl fishery for Greenland halibut is allowed, due to overfishing of the stock, which means even harder pressure on the saithe and redfish stocks.

Today we do have promising growth in both the cod and haddock stocks in the Barents Sea, and during the last three spawning seasons very high recruitment to these stocks are seen. The strong 1989 and 1990 year classes of cod and haddock will already this year recruit into trawl catches and it is believed that large areas of the Barents Sea (eastern and coastal parts) are going to be shut down for trawlers soon due to high numbers of juveniles in the catches. This situation will continue at least during the next two years (until 1994). In this view our authorities, and Russian as well, are preparing an introduction of sorting grids in bottom whitefish trawls.

Why Introduce a Sorting Grid?

Through the past decades experiments have been made to state the selectivity properties of normal codends. We do know a lot about how they work during fishing, and we are able to explain why such codends do not work in a proper way. More recent investigations and underwater observations makes us understand where and how fish are escaping during the catch period. The introduction of square mesh codends in the beginning of the 1980's was a marked breakthrough utilizing some of this knowledge, and the technique was soon shown to work on several species. During the last part of this decade square mesh codends were tested in the Norwegian fisheries as well, i.e., on Danish seines, whitefish trawls and shrimp trawls. Apart from the results obtained with Danish seines, the overall conclusions were that the technique was improper for our fisheries. We did experience severe problems in emptying the bags, redfish masking the codends, selectivity dropping at increasing catches, knotslippage, etc. The idea of using square mesh codends in the Norwegian fisheries is today more or less out of the question.

No matter the results obtained, everyone (including fishermen) in our country does agree that the size selectivity in our normal codends generally is too poor. It is also believed that an increase of the mesh size from 135 mm to 155 mm may do more harm than good! It is obvious - to the fishermen at least - that it will be almost impossible to catch haddock, saithe, redfish and other species if the mesh size is increased from 135 to 155 mm, as most sizes of these species will be sorted out. As a result and in order to make a living as fishermen, the only alternative would be to utilize the knowledge about fish behaviour and fish escapement in a negative way, i.e., manipulate the construction of codends and their mesh openings to prevent this selection. Ways of reducing the size selectivity in codends are numerous, and the real experts in this field are the fishermen themselves. Additionally, an increase of the mesh size in codends does not necessarily lead to a significant improvement of the selection on the smallest fish, but certainly more mid-sized fish (within the selection range) will escape, due to fish behaviour and ability to escape.

Due to low quotas on several important species it is desirable to improve the size selectivity of whitefish trawls, i.e., increase the ratio of large and high-valuable sizes of fish within the catches. It is also believed from a biological point of view that it is important to avoid catch of juveniles and discards of non-marketable fish.

In order to obtain improved size selection on fish it is very obvious that use of normal, diamond mesh codends and (small) changes of mesh sizes is a trap. Both the square mesh and the sorting grid trials show that it is absolutely necessary to use codends with fixed openings that will not be affected and close as the catches grow in size.

The ideas behind the Sort-X were to develop a system that would guarantee a constant size selection of fish, no matter densities or catch sizes. Furthermore, I saw it as important to do the size selection before (juvenile) fish were totally exhausted and before they entered the codend and had a chance to mix up with larger fish, thus reducing their possibility for escapement. Finally, the exact codend mesh size downwards would be of less importance if a sorting grid could work the intended way, and a lot of time-consuming and expensive effort of controlling codends mesh sizes could be reduced.

The 1990 Experiments

During 1990, four trials were carried out in the Barents Sea waters, using ordinary trawlers sized 32-57 m. The experiments were made in March, May, August/September and November, revealing good results, i.e., sharper selection curves on cod (Gasus morhua) and haddock (Melanogrammus aeglefinus) compared to results with standard 135 mm codends. All the trials were conducted with normal bottom trawls (Alfredo, Cotesi and Atlantic Western designs) and the catch sizes varied from 300 kg to 7,000 kg pr. towing hour.

Since May 1990 no vital changes of the Sort-X has been introduced. Rather low angles of attack of the system, the use of stainless steel grids and bardistances of 55 mm are shown to be important and beneficial for our cod fishery (i.e., catch of cod > 47 cm and haddock > 44 cm, which are the minimum landing sizes).

The 1991 Experiments

Fishermen, their organizations and the authorities do agree that this new technology brings us a long step towards wanted improvement of the selectivity with respect to trawl codends, and that a technique like the Sort-X may solve many problems by fisheries management.

In spite of convincing results obtained, fishermen (and others) still hesitate in their final approval of the technique. The main reason for this is lack of information on the effects on species like saithe (Pollachius virens), redfish (Sebastes spp.) and Greenland halibut (Reinhardtius hippoglossoides) if the Sort-X is used. These species have become rather important to our trawlers due to extreme low quotas on cod and haddock.

Consequently, the main activities in 1991 were aimed towards these species, but, unfortunately, the programmes at sea were delayed. Four experiments with the Sort-X were made during 1991. The first trials were carried out on board a 59 m Russian trawler (joint Soviet-Norwegian selectivity experiments) during May. Only cod and haddock were caught. The second experiment was made during August/September with a 47 m Norwegian trawler. Again, rather few data on saithe and redfish were obtained. No Greenland halibut were caught. However, during these experiments the effects on size selectivity by reducing the bardistance from 55 mm to 50 mm were established. The third experiment was made in November with a 57 m factory trawler, and data on Greenland halibut, redfish (mainly Sebastes mentella), cod and haddock were obtained. During the fourth trial a smaller version of the Sort-X was tested on board a 20 m vessel rolling the system (when turned upside-down) on the netdrum at the stern. Data on cod, haddock, saithe and redfish were obtained.

The 1992 Experiments

During March 1992 more data on redfish spp. (Sebastes Mentella and Sebastes Marinus), saithe, haddock and Greenland halibut were collected during trials with 40 mm, 45 mm and 50 mm Sort-X systems. These experiments were carried out on board a 57 m factory trawler along the western coast of northern Norway. Several large catches (15 - 16 tons of fish, roundweight) were made during 2 and 3 hour hauls, and the catches were mixed up with a high ratio of (spawning) cod. At several occasions the small meshed cover retaining escaping fish broke due to heavy loads (3 tons of fish or more), especially at good catches of saithe, and valuable selectivity data were lost. During some of these experiments too few within the selection were caught on these fishing grounds, producing some odd results (i.e., especially data on haddock and Greenland halibut).

Further Studies

Despite a large amount of selectivity data on the most important species for our trawl fisheries, the persons concerned are not ready to decide whether the sorting grids really are an alternative to mesh size regulations, or not. It will during this year be performed some trials on commercial vessels using the sorting grid over a longer period to test the technical function of the system over time (lifetime of a grid) and to examine the catch compositions (fish sizes) and the outcome for those vessels using the system, compared to vessels that do not use the system. If the results of these trials are positive, the fishermen are ready to use sorting grids in whitefish trawls on a voluntary basis.

The Russians do fish on the same stocks as we do, and as mentioned quotas are equally shared between our two nations. Therefore, another and important aspect in introducing a sorting grid system in whitefish trawls is what the Russians decide to do. The two nations have, as a result, decided to do a joint experiment on sorting grid selectivity during this summer, and the conclusions of the report from this joint experiment will be important for further decisions.

Other Experiments

During June 1991 my colleague Bjömar Isaksen (Inst. of Fish. Res., Bergen) and I made some initial tests with small sorting grids in the codends of ordinary Danish seines, and the results were extremely good and quite unexpected. Selection ranges for cod and haddock of 4.5 - 5.2 cm (with L50% 's of 50 - 51 cm) were experienced. Only three hauls were made, and the results were obtained by 55 mm bardistance, small meshed cover over the sorting grids and an ordinary 135 mm PE codend (no small meshed blinder was used). Compared to the length-distributions of fish from Danish seine with ordinary 135 mm codends (and no grids), the improvements with respect to the size selectivity were very significant.

During January 1991 Fisheries and Oceans and FPI in St. John's, Canada, started their first experiments with the Sort-X technology. The results were encouraging, and more trials will be made. The Russians (PINRO, Murmansk) have carried out three separate test periods with the Sort-X, and the experiments are made on cod and haddock in the south eastern and northern parts of the Barents Sea. The Institute of Fisheries Research on the Faroe Islands are going to do some experiments on saithe during this spring, using 50 mm grids. In Finland good results on separating small (undersized) herring from larger ones are obtained by the Sort-X technique (with bardistances of 14 mm). The experiments were made with pelagic trawls in depths of 20 - 50 m. Some experiments are run in Scotland and on Iceland with the technique, but the results remain unknown to me. During the end of October 1991 experiments with a Sort-X system (and different bardistances) were made along western Africa, Namibia, working on hake, horse mackerel and other species. The fish/shrimp separating device (the Nordmöre grid) was during Autumn 1991 tested (by Bjömar Isaksen) in the Tanzanian coastal waters, but the results were rather poor due to the sizes of shrimps and fish (bycatch). Using a modified version of the Sort-X, encouraging results were obtained, and further experiments are planned to be made.

Results with the Sort-X

During the 1990 experiments (and partly during the '91 tests) large numbers of selectivity data on cod and haddock are produced. All data show a significant improvement on size selectivity with the Sort-X compared to ordinary 135 mm meshes, and the results are shown in Table 1. It is believed that only minor improvements may be gained with respect to these two species in further development of the technique.

The data obtained so far on other species are insufficient, and more experiments are planned and will be made in the near future. Comparisons of the effects when reducing the Sort-X bardistance from 55 to 50 mm were studied during the August/September '91 experiments, and the results are shown below. During this test period the catches exceeded 10,000 kg of fish per towing hour at several occasions, without any change in the selectivity properties, i.e., middle selection points and selection ranges. The results obtained on saithe, Greenland halibut and redfish spp. during November 1991 and March 1992, show that the bardistance of the Sort-X should be reduced with respect to these species, compared to the bardistance used on cod and haddock.

Fishing on mixed species, the bardistance chosen should allow for sufficient escapement of juveniles. Due to different minimum landing sizes of fish (i.e., cod - 47 cm; haddock - 44 cm; saithe - 40 cm; Greenland halibut - 45 cm, etc.), it is rather impossible to find or advise about "the correct bardistance" of the Sort-X (as for any codend mesh size). A Sort-X with 50 mm bardistance (or even less), may be correct when fishing on saithe, or redfish, or Greenland halibut. However, reducing the bardistance of the Sort-X from 55 mm to 50 mm shows that too large numbers of undersized cod and haddock may be caught.

There are two ways of solving this "problem": Change (increase) the minimum landing sizes of saithe and other species, or by using two different bardistances in the sorting grids in our waters. The eastern and northern parts of the Barents Sea are mainly cod and haddock grounds, and in these areas 55 mm bardistance should be used. Further west (along the western coast of Norway) species like saithe, redfish and Greenland halibut are caught, and use of a smaller bardistance should be possible and practical. When cod and haddock occur (winter-spring) on these grounds it is large fish during their annual spawning migration.

Tables 1 to 4 gives data on test programmes run and results obtained on cod and haddock during the 1990 experiments. Tables 5 to 9 show the results obtained on the species cod, haddock, saithe, redfish and Greenland halibut during the period May 1990 to March 1992, where several vessels are used and different bardistances of the sorting grids have been tested. In Table 10 a list showing period of experiments, vessel names, bardistances used and species investigated. Figures attached show where the sorting grids are placed in the trawl, experimental set-up with covers and codend blinders and the working principles of the Sort-X system.

TABLE 1

Periods of experiments with the sorting grid system in commercial fish trawls, fishing areas and data of the vessels used during 1989 and 1990.

Period. *No. of days*	*Area of experiments*	*Vessels used* *Name*	*Size, m*	*Horsepower*
October 1989, 8 ds	*Fiords in Troms*	*"Johan Ruud"*	*30.6 m*	*1000 HP*
March 1990, 15 ds & *Aug./Sept. 1990, 14 ds*	*Coast of Finnmark & Nordbanken*	*"Anny Kræmer"*	*51.8 m*	*2400 HP*
May 1990, 10 days	*Coast of Finnmark & Nordbanken*	*"Remifisk"*	*32.5 m*	*660 HP*
November 1990, 8 ds	*Nordkappbanken & Skolpenbanken*	*"Prestfjord"*	*56.9 m*	*3000 HP*

TABLE 2

Different variables of the sorting grids tested in commercial fish trawls during 1989 and 1990.

System No.	*Period*	*Sorting area (m^2)*	*Bardistance*	*Angle of attack*	*Type of material*
0	*October'89*	*1.0*	*50 mm*	*60°*	*AL[1]*
1	*March'90*	*2.0*	*60 mm*	*60°*	*AL*
2a	*March'90*	*1.9*	*55 mm*	*60°*	*AL*
2b	*March'90*	*1.9*	*55 mm*	*35°*	*AL*
3	*March'90*	*1.9*	*52 mm*	*60°*	*AL*
4	*March'90*	*5.2*	*55 mm*	*45 & 0°*	*AL*
5	*May'90*	*1.9*	*55 mm*	*35°*	*ALCOMP[2]*
6	*May'90*	*3.2*	*55 mm*	*35 & 0°*	*ST[3]*
7	*May'90*	*4.7*	*55 mm*	*30 & 0°*	*ST*
8	*Aug./Sept.'90*	*3.2*	*55 mm*	*30 & 0°*	*ST*
9	*November'90*	*3.2*	*55 mm*	*30 & 0°*	*ST*

[1] Aluminium (AL) resistant to seawater. [2] Aluminium composite (a new product) is harder and stronger than ordinary AL. [3] Stainless steel (ST). Additionally, 5 different constructions of flappers in front of the sorting grids were tested (system 0 to 4), various numbers of floats were used on each system and three different principles to guide escaping fishes away from the trawl were tested.

TABLE 3

Middle selection points and selection ranges for cod (Gadus morhua) obtained during the experiments in 1990, using different sorting grid systems on board commercial trawlers.

System No.	Period, Month/Year	Middle selection point ($L_{50\%}$)	Selection range ($L_{75\%}$ - $L_{25\%}$)
1	March 1990	48.2 cm	25.7 cm
2a	March 1990	35.0 cm	16.5 cm
2b	March 1990	47.4 cm	11.7 cm
3	March 1990	38.0 cm	20.8 cm
4	March 1990	42.2 cm	18.0 cm
5	May 1990	51.1 cm	9.0 cm
6	May 1990	52.2 cm	7.0 cm
7	May 1990	51.5 cm	5.8 cm
8	Aug./Sept. 1990	49.6 cm	8.5 cm
9	November 1990	51.3 cm	6.9 cm

TABLE 4

Middle selection points and selection ranges for haddock (Melanogrammus aeglefinus) obtained during the experiments in 1990, using different sorting grid systems on board commercial trawlers.

System No.	Period, Month/Year	Middle selection point ($L_{50\%}$)	Selection range ($L_{75\%}$ - $L_{25\%}$)
1	March 1990	53.0 cm	11.0 cm
2a	March 1990	48.2 cm	14.0 cm
2b	March 1990	48.2 cm	6.2 cm
3	March 1990	46.0 cm	10.0 cm
4	March 1990	50.0 cm	16.2 cm
5	May 1990	48.4 cm	8.6 cm
6	May 1990	50.6 cm	5.7 cm
7	May 1990	48.7 cm	6.5 cm
8	Aug./Sept. 1990	47.8 cm	6.3 cm
9	November 1990	49.7 cm	8.3 cm

Table 5: Results obtained on cod (Gadus morhua) with the Sort-X during the period May 1990 (when the stainless steel grids were introduced) to November 1991, showing the experimental periods, vessels used, type of Sort-X used, middle selection points and selection ranges.

Cod (Gadus morhua)

Month/ Year	Vessel name & length/engine Bhp	Type of Sort-X (bardistance)	Middle selection	Selection range
May 1990	"Remifisk", 32.5 m/660 Bhp	55 mm 55 mm	52.2 cm 51.5 cm	7.0 cm 5.8 cm
Aug./Sept. 1990	"Anny Kræmer", 51.8 m/2400 Bhp	55 mm	49.6 cm	8.5 cm
November 1990	"Prestfjord", 56.9 m/3000 Bhp	55 mm	51.3 cm	6.9 cm
May 1991	"Genichesk", 69.0 m/2200 Bhp	55 mm 55 mm	48.6 cm 49.3 cm	9.9 cm 9.3 cm
Aug./Sept. 1991	"Skjervøyfisk", 46.7 m/1250 Bhp	55 mm & 50 mm	49.5 cm -	7.4 cm -
November 1991	"Gullstad" 19.9 m/500 Bhp	55 mm	51.8 cm	5.8 cm
November 1991	"Prestfjord", 56.9 m/3000 Bhp	50 mm & 40 mm	48.1 cm 38.3 cm	7.9 cm 3.2 cm

Table 6: Results obtained on haddock (Melanogrammus aeglefinus) with the Sort-X during the period May 1990 (when the stainless steel grids were introduced) to March 1992, showing the experimental periods, vessels used, type of Sort-X used, middle selection points and selection ranges.

Haddock (Melanogrammus aeglefinus)

Month/ Year	Vessel name & length/engine Bhp	Type of Sort-X (bardistance)	Middle selection	Selection range
May 1990	"Remifisk", 32.5 m/660 Bhp	55 mm 55 mm	50.6 cm 48.7 cm	5.7 cm 6.5 cm
Aug./Sept. 1990	"Anny Kræmer", 51.8 m/2400 Bhp	55 mm	47.8 cm	6.3 cm
November 1990	"Prestfjord", 56.9 m/3000 Bhp	55 mm	49.7 cm	8.3 cm
May 1991	"Genichesk", 69.0 m/2200 Bhp	55 mm 55 mm	49.3 cm -	8.3 cm -
Aug./Sept. 1991	"Skjervøyfisk", 46.7 m/1250 Bhp	55 mm & 50 mm	50.2 cm 44.8 cm	4.6 cm 8.6 cm
November 1991	"Prestfjord", 56.9 m/3000 Bhp	50 mm & 40 mm	45.9 cm 39.3 cm	8.8 cm 4.5 cm
November 1991	"Gullstad", 19.9 m/500 Bhp	55 mm	50.3 cm	8.1 cm
March 1992	"Prestfjord", 56.9 m/3000 Bhp	50 mm	44.1 cm	16.7 cm??

Table 7: Results obtained on saithe (Pollachius virens) with the Sort-X during the period May 1990 (when the stainless steel grids were introduced) to March 1992, showing the experimental periods, vessels used, type of Sort-X used, middle selection points and selection ranges.

Saithe (Pollachius virens)

Month/ Year	Vessel name & length/engine Bhp	Type of Sort-X (bardistance)	Middle selection	Selection range
Aug./Sept. 1990	"Anny Kræmer", 51.8 m/2400 Bhp	55 mm	52.7 cm	18.4 cm
Aug./Sept. 1991	"Skjervøyfisk", 46.7 m/1250 Bhp	55 mm & 50 mm	49.2 cm 47.1 cm	7.4 cm 10.5 cm
November 1991	"Gullstad", 19.9 m/500 Bhp	55 mm	56.1 cm	6.9 cm
March 1992	"Prestfjord", 56.9 m/3000 Bhp	40 mm & 45 mm & 50 mm	41.8 cm 35.4 cm?? 49.8 cm	5.9 cm 8.0 cm 13.9 cm

Table 8: Results obtained on redfish (Sebastes species) with the Sort-X during the period August/September to March 1992, showing the experimental periods, vessels used, type of Sort-X used, middle selection points and selection ranges.

Redfish (Sebastes mentella* & Sebastes marinus**)

Month/ Year	Vessel name & length/engine Bhp	Type of Sort-X (bardistance)	Middle selection	Selection range
Aug./Sept. 1990	"Anny Kræmer", 51.8 m/2400 Bhp	55 mm	ca. 38 cm	too small samples
Aug./Sept. 1991	"Skjervøyfisk", 46.7 m/1250 Bhp	55 mm & 50 mm	40.3 cm *+** 35.6 cm *+**	10.1 cm 10.2 cm
November 1991	"Prestfjord", 56.9 m/3000 Bhp	50 mm & 40 mm	33.9 cm * 29.3 cm *	12.7 cm 8.1 cm
November 1991	"Gullstad", 19.9 m/500 Bhp	55 mm	42.7 cm **	7.8 cm
March 1992	"Prestfjord" 56.9 m/3000 Bhp	40 mm & 45 mm & 50 mm & 50 mm	26.0 cm *+** 22.8 cm *+** 34.1 cm *+** 27.8 cm *	9.9 cm 10.6 cm 14.5 cm 3.9 cm

Table 9: Results obtained on Greenland halibut (Reinhardtius hippoglossoides) with the Sort-X during November 1991 and March 1992, showing the experimental period, vessel used, type of Sort-X used, middle selection points and selection ranges.

Greenland halibut (Reinhardtius hippoglossoides)

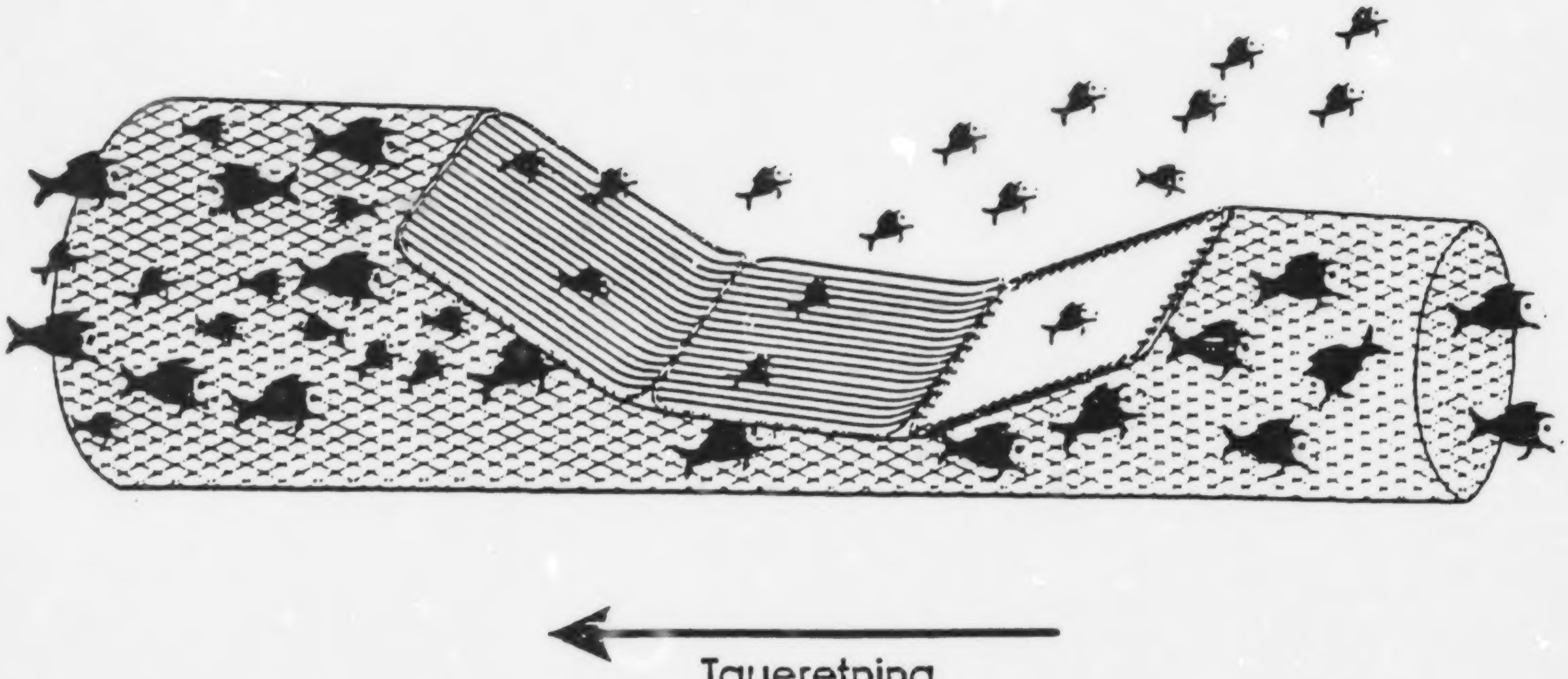
Month/ Year	Vessel name & length/engine Bhp	Type of Sort-X (bardistance)	Middle selection	Selection range
November 1991	"Prestfjord", 56.9 m/3000 Bhp	50 mm & 40 mm	39.9 cm 37.8 cm	13.5 cm 10.3 cm
March 1992	"Prestfjord", 56.9 m/3000 Bhp	45 mm & 50 mm	33.3 cm 30.1 cm	7.0 cm 7.5 cm

Table 10: Different testperiods with the Sort-X technology made by the Norwegian College of Fishery Science, University of Tromsö, in the period from March 1990 to March 1992 .

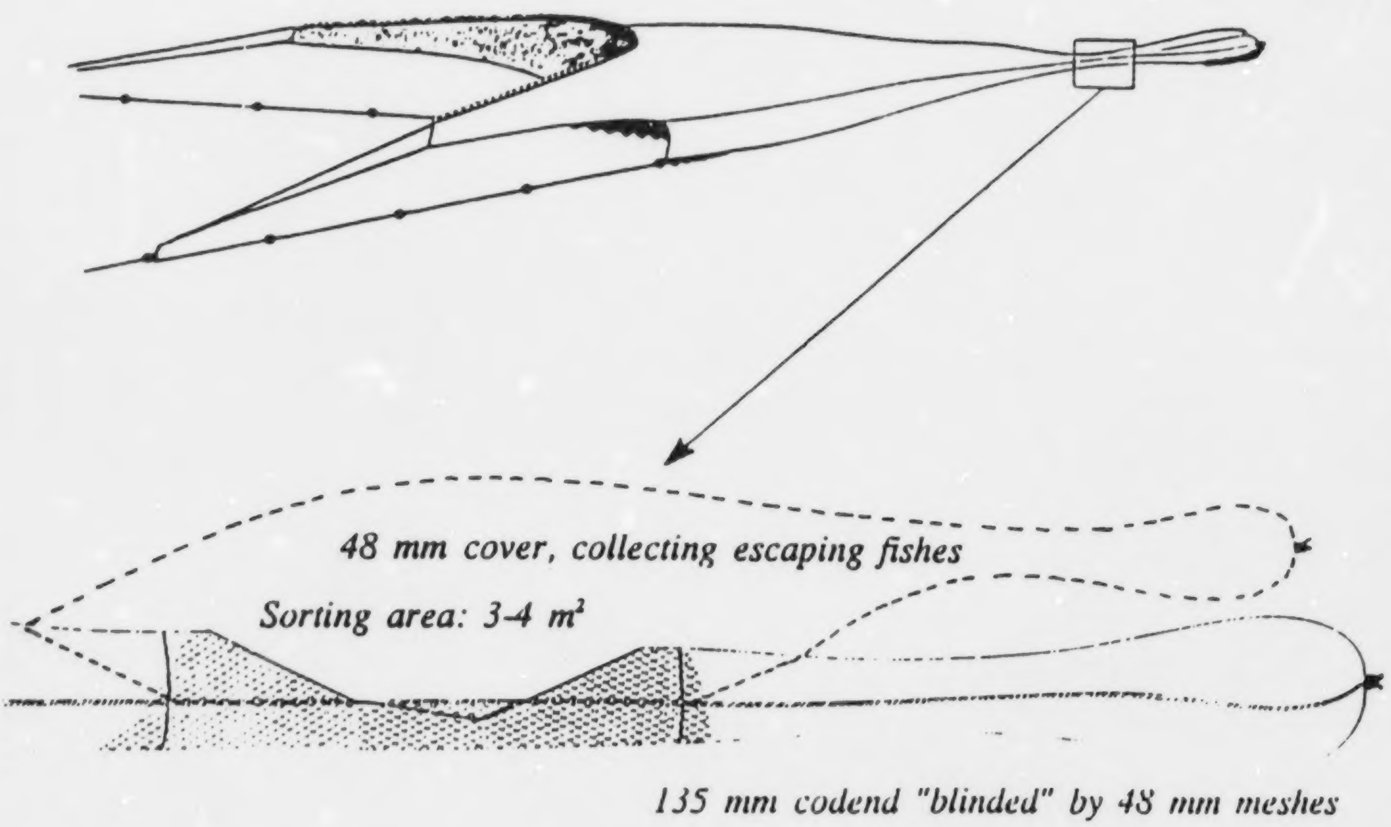
Experimental period	Vessel used	Sort-X bardistance	Species investigated
March 1990 16 days	"Anny Kræmer" stem trawler	55 mm	cod and haddock
May 1990 10 days	"Remifisk" longliner/trawler with netdrum	55 mm	cod and haddock
Aug/Sept 1990 14 days	"Anny Kræmer" stem trawler	55 mm	cod, haddock and saithe
November 1990 8 days	"Prestfjord" stem trawler	55 mm	cod and haddock
May 1991 14 days	"Genichesk" stem trawler (russian vessel)	55 mm	cod and haddock
Aug/Sept 1991 12 days	"Skjervøyfisk" stem trawler	55 and 50 mm	cod, haddock, saithe and redfish
November 1991 10 days	"Prestfjord" stem trawler	50 and 40 mm	Greenland halibut, redfish, cod and haddock
November 1991 12 days	"Gullstad" trawler (netdrum)	55 mm (small Sort-X version)	Cod, haddock, saithe, redfish
March 1992 11 days	"Prestfjord" stem trawler	40, 45 and 50 mm	Redfish, saithe, Greenland halibut, ~~haddock~~

Sort-X

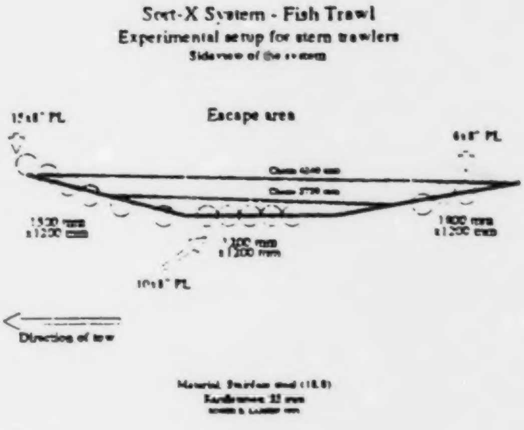
Prinsippskisse

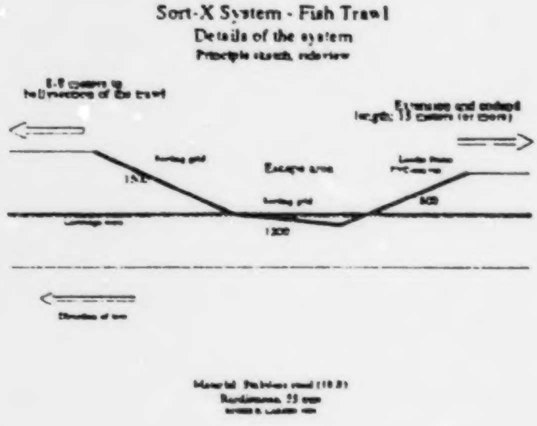

Taueretning

SIDEVIEW OF THE SORTING GRID SYSTEM

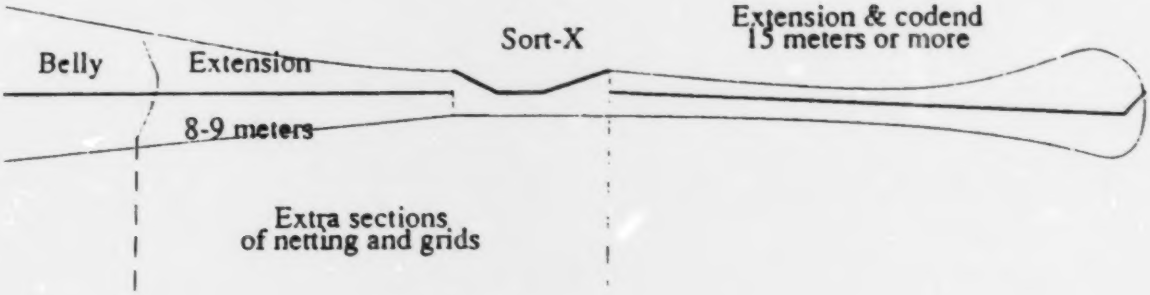

48 mm cover, collecting escaping fishes
Sorting area: 3-4 m²
135 mm codend "blinded" by 48 mm meshes

ROGER B. LARSEN 1990


Sort-X System - Fish Trawl
Experimental setup for stern trawlers
Sideview of the system
15x8" PL
Escape area
6x8" PL
1500 mm
x1200 mm
1800 mm
x1200 mm
1200 mm
x1200 mm
10x8" PL
Direction of tow
Material: Stainless steel (18.8)


Sort-X System - Fish Trawl
Details of the system
Principle sketch, sideview
Extension and codend
length: 15 meters (or more)
Sorting grid
Escape area
Sorting grid
1200
Direction of tow
Bardistance 55 mm

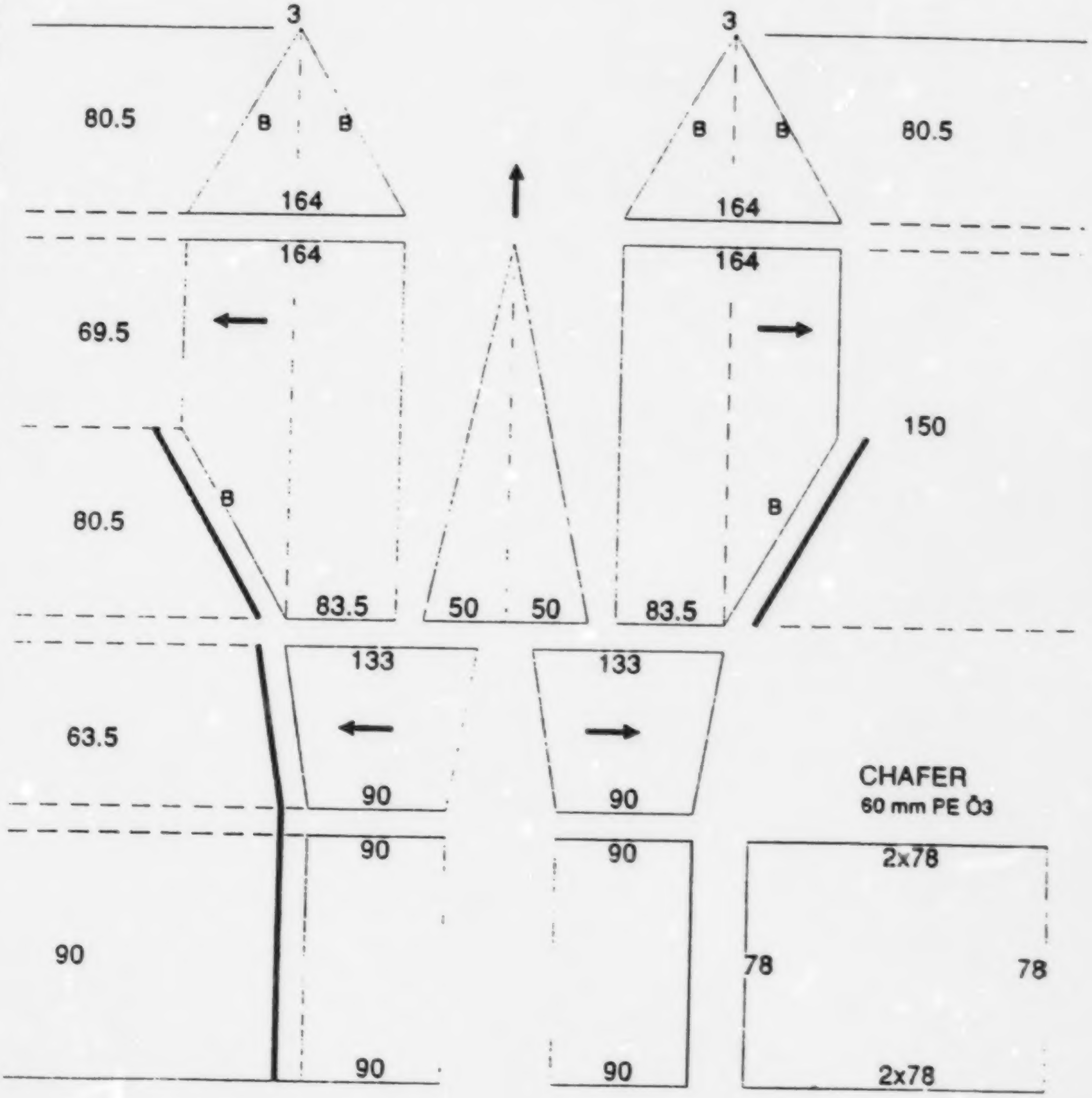
Sort-X System - Fish Trawl
Attachment to the trawl
Principle sketch, sideview


Belly
Extension
8-9 meters
Sort-X
Extension & codend
15 meters or more
Extra sections
of netting and grids

Trawl sizes: normal 420-650 # x 150 mm
Bardistance in sorting grids: 55 mm
ROGER B. LARSEN, NFH 1991

Cover for codtrawl Sort-X experiments

Construction drawings, all panels in
52 mm Ø1.8 mm PE (courlene).


3
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164
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69.5
150
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B
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50
50
83.5
133
133
63.5
90
90
CHAFER
60 mm PE Ø3
90
90
2x78
90
78
78
90
90
2x78

ROGER B. LARSEN, NFH 1990

DEVELOPMENT OF THE SORT-X SYSTEM FOR BOTTOM FISH TRAWLS AND RESULTS FROM SOME OF THE EXPERIMENTS DONE WITH DIFFERENT GRID BARDISTANCES

By

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Canadian Mobile Gear Selectivity Workshop

St. John's & Halifax, April 27 - May 1 1992

* The number of Norwegian trawler with quotas for cod: 86, and additional 45 vessel (>27.5 m) have shrimp/cod quotas

* Fishing in the Barents Sea for cod, haddock, saithe, redfish, etc., the minimum mesh size is 135 mm (or 145 mm) for norwegians and 125 mm for russians

* Minimum landing sizes are: Cod (47 cm), haddock (44 cm), saithe (40 cm), Gr. halibut (45 cm), redfish (none)

Norwegian quotas (tons) in the areas north of 62°N during 1991 and 1992, and the 1992 TAC for the areas agreed between Russia (USSR) and Norway.

Species	1991	landed 1991	1992	TAC 1992
Cod	128.500	153.600	165.000	340.000
Haddock	19.500	22.000	32.000	55.000
Saithe	97.000	103.800	112.000	115.000
Redfish spp.	36.000	43.200	47.000	
Gr. halibut	7.000*	29.000**	2.000*** ?	6.000

* Quotas within Norwegian Ecomic Zone (200 mile), ** catches included landings from the Spitzbergen region (no quotas), *** No trawl fishery during 1992, catches to be taken by conventional gears as lonlines and gillnets (i.e. norwegian fishermen).

* During 1992 the norwegian trawlers are allowed to fish ca. 28% of the national quotas on cod, haddock and saithe, i.e. 46.200 tons of cod, 8.000 tons of haddock and 38.000 tons of saithe

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* Ideas and the basic principles were observed during a cruise in June/July 1988 ("Anny Kræmer")

* A pilot test with the first sorting grid for bottom fish trawls was made during Oct. 1989 (R/V "Johan Ruud")

* The development and works were organized as a wide co-operation between researchers and local private companies during 1990. The development was financed by public and private funds, later only public funds

* During 1990 four different experiments were made on different vessels. Some underwater observations were made as well: March on board the 52 m "Anny Kræmer", May the 32 m "Remifisk", August/September "Anny Kræmer" and November the 57 m "Prestfjord"

* During 1991 four different experiments were made: May on board the russian "Genichesk" (60 m), August/September "Skervøyfisk" (47 m), November "Gullstad" (20 m) and "Prestfjord" (57 m)

* March 1992 the 57 m "Prestfjord"

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The problems of achieving effective size selectivity with normal (diamond mesh) codends are wellknown:

* Nonsharp selectivity

* Reduced selectivity at growing catches or larger catches/unit time

* Increased mesh size will remove marketable sizes of fish, but not necessarily more juveniles !

* The effects by increased mesh sizes may (will?) be compensated for by changes of the codend constructions

* Modern codends used in (larger) gears may cause severe damages to escaping juveniles, due to the stiff and heavy materials used

* Square mesh codends do improve size selectivity at smaller catches, but they are impractical in our fishery, and the good size selection drop at more normal and larger catch sizes

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The principles of this new technology are simple. Keywords are fish shape and fish behaviour:

* Fish will react to the change between meshes and metal bars: Change in light intensity and water flow may be the answer to this reaction.

* Fish are given a fear possibility to escape through this section of bars on their way to the codend - and way in front of it.

* Juvenile fish will pass easily between the bars, while larger fish are retained and must continue towards the codend.

* The turnover in front of the sorting area is observed, and it is high.

* Escaping fishes are observed to pass fast and calmly between the bars. See illustration.

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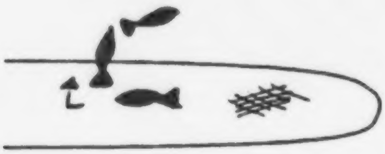
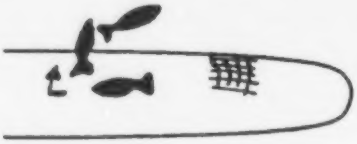
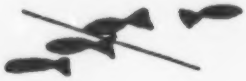
Escapement through a diamond mesh
codend, change in swimming position
and hit a certain mesh opening



Escapement through a square mesh
codend, change in swimming position
and hit a certain mesh opening



Escapement between grid bars
No change in swimming position



The practical experiments with the sorting grids are all made on board commercial fishing vessels. In total 120 days of experiments

During the test programmes several variables are studied:

* Distance between the bars:40, 45, 50, 52, 55 & 60 mm
* Sorting areas: 1.9, 2.0, 3.2, 4.7 & 5.2 sq.m.
* Angles of attack: 60, 45, 35 & 30 degrees
* Grid materials: AL, ALcomp & ST
* Water flows and angles of attack were measured
* Different systems are observed by a ROV vehicle

Canadian Mobile Gear Selectivity Workshop
St. John's & Halifax, April 27 - May 1 1992

The results with the technology are good:

* The best results are found when using sorting grids made of stainless steel.

* A 55 mm sorting grid will give selection points for cod and haddock close to those achieved by 135 mm normal codends

* The middle selection points are 50 to 52 cm for cod and 48 to 50.5 cm for hadock when a bardistance of 55 mm is used

* The corresponding selection ranges are 6 to 9 cm (cod) and 6 to 8.5 cm (haddock)

* The sharper selection achieved with sorting grids compared to normal (135 mm) codends, results into less juveniles caught. Of all juveniles entering the trawl, more than 90% will escape through the sorting grid

* This selectivity is not affected by catch sizes or catches/unit time. The codend mesh size downwards or the construction of the codend is of no importance

Canadian Mobile Gear Selectivity Workshop

St. John's & Halifax, April 27 - May 1 1992

During the experimental periods very few practical problems were seen:

* The sorting grids are placed in the extension piece, in front of the codend(s). Total weights, including floats, does not exceed 100 kg

* No special precautions are taken when handling a "sorting grid trawl", but we lack informations from practical fishing over longer periods

* The parts of the system are jointed to each other and the stretch forces of the trawl will open the system once in sea. The system will always be in a right position during fishing

* The selection points of fish may easily be altered by changing the distance (lumen size) between the bars

* The technology may be used in both bottom and pelagic trawls

* This grid technology may be more gentle to escaping fish (juveniles) compared to mesh escapement.

UNITED KINGDOM INDUSTRY EXPERIENCE

By

John Ashworth
Fishing Gear Technologist
England, UK

UNITED KINGDOM INDUSTRY EXPERIENCE

We are all very fortunate here today, that we have administrators, scientists, and the industry talking together. I can assure you that this is very rare, and I would love to see this dialogue taking place in Europe.

Another unique feature of this meeting is we have here two European scientific field workers. The system in Europe does not allow those who go out to sea to broadcast their views and findings, it is controlled by their senior management people who have hardly or ever been on a commercial fishing vessel, and who follow policies that bear no resemblance to the industry's requirements.

One thing we have to remember is that whatever the Administrators do, whatever the scientists say, it is the industry that picks up the tab. It is our future that is at stake.

Your government has recognized that fact, but at the same time, the industry must take responsibility. That means we have the duty not only to care for the resource, and in turn keep ourselves in employment, but to provide nations with a very important food source. This can only be done with total co-operation across the board. It also means the industry must put its own house in order, and must recommend and implement its own ideas.

We in Europe have the situation where the industry puts forwards ideas, not always listened to, and usually ends up fighting and disagreeing with administrators and scientists, and also ourselves internally within the industry. The result - we don't make much progress.

So I say to you today, don't miss this opportunity.

While I am a gear manufacturer, I have always been interested in how we can increase the resource, and why do we always seem to be on the downward slope.

I have campaigned for a long time for the introduction of more selective gear, and especially square mesh. As Jack Robertson has already stated, the square mesh panel was introduced into the UK fishing industry last year, which was a major achievement, and I can assure you, and I could talk for hours of the uphill struggle for this introduction, but will leave it by saying it was against the odds.

I think I am correct in stating that Jack conducted all the underwater filming of the square mesh panels on commercial and scientific vessels. It was this filming that convinced fishermen that this was a good and acceptable system in reducing discards, and those fishermen on board the commercial vessels that took part in the research broadcasted the fact to other fishermen. It was not scientific data, retention lengths, graphs, statistics, and endless scientific meetings that convinced fishermen, but the filming, the visual effect, to be shown exactly what was going on down there, and the time scale that all this took place in was very short.

Last year three significant events took place. Firstly, the convincing use of underwater filming, which speeded up the process of research. Not only convincing for the fishermen, but also politicians and the general public. Secondly, after this tremendous burst of activity and the introduction of the square mesh panel, everything went dead, as it to say that's it, and yet this was the very moment to refine and improve this introduction, which if we don't, we could lose it. Thirdly, a meeting took place of European and other countries scientists, to discuss cod-end selectivity. The result of this was after decades of research agreement could not be reached on the methodology of how to conduct and present research, which in turn needed further research, but at the same time, they, the scientists, were the ones to carry selectivity research.

Myself, and a group of colleagues within the industry felt enough was enough, we would decide our own objectives, our own targets, and carry out our own research.

How were we going to do this?

Our first priority was we had to have our own underwater TV system. We have to know what is going on down there. Bearing in mind this research is coming out of individuals own pockets, we could not just go out and purchase a towed underwater vehicle, nor at this stage do we need one, because we want to see what is happening inside towed gear, and also with static gear.

Our first effort was to place an ordinary camcorder inside a water proof housing. this worked well if we had clear water and good light, down to about 10 fathom. Unfortunately, we very rarely have those conditions. Our second stage was to use the waterproof housing to contain the power pack, video recorder, and time switches (the housing in 8.5 inches in diameter x 16 inches long) and have a connecting cable of varying lengths to a low light camera. We have another camera on order for very low light conditions. We can use these cameras, either with the housing which means we get the film back when we haul, or we can have the cable back to the vessel.

To build this system has not been easy, and it has taken us about five months, to locate all the parts we need, build what is not available, and this has been done by people in their spare time, not as part of their job.

The evening before I left to come here, my Skipper colleague collected all stage 2 equipment to put into operation.

We are now confident we have broken the back of designing our own underwater TV monitoring system, and I am pleased to say you will soon have a system here in Canada.

Having now got this facility, what we are going to do with it.

Our objectives in selectivity research is as follows:

To design gear that will take from the seas, oceans, and lakes: The species we want, of the size we want, leaving everything else intact.

A tall order you might say, but one I and my colleagues feel worth going for. We want to harvest, not hunt.

If I go through each section: species we want.

It would be a tremendous help to fishery management if we could get some way towards this, not only for conservation but also for marketing. The size we want. The same applies, conservation and marketing. Using the most profitable size, and the size the customer wants. Leaving everything else intact. We don't want to kill all the species and sizes we don't want. They will be useful and marketable at a later date. We don't want to destroy the marine environment, by that I am talking about the eco system, it is very easy to break the food chain cycle, and you find yourself increasing the stock, with nothing for it to feed on.

How are we going to achieve this?

We are relying heavily on underwater TV monitoring. We will always work on commercial vessels, during normal fishing operations. We will make decisions, and by we, I mean our small group and the fishermen we are working with, on a day-to-day basis. My own experience of developing items for the fishing industry is that you must leave those onboard to make decisions and change direction if they see fit, and not tie them down to a rigid brief.

As far as towed gear is concerned, our first operation is to observe species behaviour just prior to the extension. If it is at all possible, this is where we want selectivity to take place, because we want the juveniles to escape as soon as possible so they don't receive abrasive damage by entering the extension and cod end and then escaping and dying at a later date. We want to use escape panels of either square or oblong mesh, or a system that does not, like diamond mesh, constantly change opening size during a tow. The other reasons why we would like to see the escape panels further forward is it does not cause so many technical problems, such as twisting cod-ends, and wash-out, etc. Also it is very easy for fishermen to circumvent regulations to do with extensions and cod-ends. We all know what those are, and are common throughout the world.

It has been stated by scientists that in order for a species to want to try and escape through a panel they need sometimes a stimulus. The scientists have suggested everything except what we are going to try, and that is a noise barrier, and I am not going to say any more about that now, as it can be a good topic for later discussion.

Why is it important for the industry to become involved with research. Fishermen and fishing gear designers and manufacturers have met every challenge to find ways of catching everything we want to catch, and continually improve. Surely then, these are the best people to design fear to our objectives. In some quarters, and thankfully not all, it is thought that only scientists are the ones that know anything and put forward the future changes and legislation. But what is science, it is an observation of natural phenomena, and who as far as fishing is concerned has the most experience of that - fishermen. And who has studied gear the most - the people who design and manufacture gear with fishermen's support.

I am not saying scientists have no role to play. They have, but one sector should not dominate and include the others. That is why we are here now, it is far better for everyone to pool their knowledge and cooperate together for the good of the resource, rather than work in conflict. We in the United Kingdom are in total conflict with each other, even between government departments and within the industry. Not the best way to achieve anything.

Lastly, our own research is important for the environmentalists. We the industry must know what is going on internally, and I believe we should have a good PR person ready to defend the industry's position, and that means having at their finger tips, visual means for the media. Whatever good intentions the environmentalists have, and again it is better to be on speaking terms with them rather than in conflict, but in any society there will always be a radical, or miss-informed group, that will take the industry on and if we are not prepared, you know what that will mean and who will be the losers.

GULF OF ST. LAWRENCE
INSHORE MOBILE GEAR SELECTIVITY

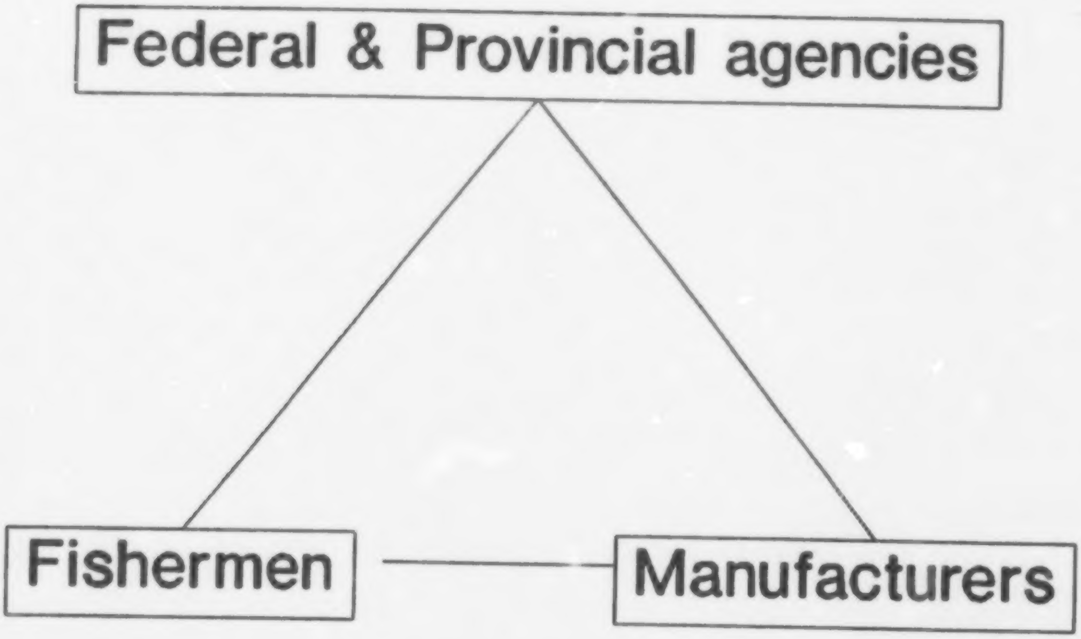
MESH SIZE ASSESSMENT
SPLIT PANEL TRAWL

By

Marcel Boudreau
DFO, Quebec

Mobile Gear Selectivity

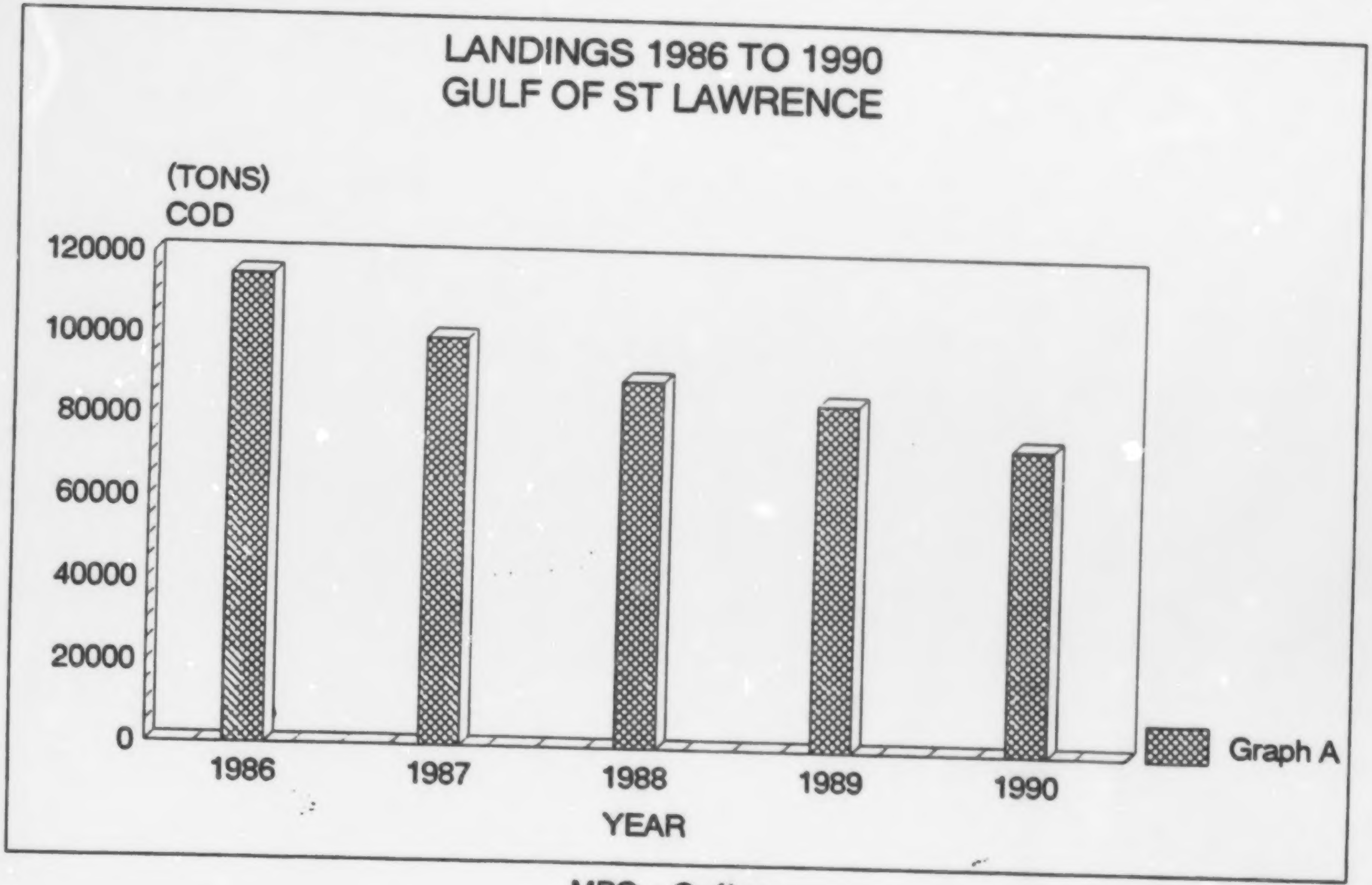
Atlantic Workshop



Federal & Provincial agencies

Fishermen

Manufacturers


LANDINGS 1986 TO 1990
GULF OF ST LAWRENCE
(TONS)
COD
120000
100000
80000
60000
40000
20000
0
1986
1987
1988
1989
1990
YEAR
Graph A

MPO – Québec

SELECTIVITY PROJECTS IN THE GULF OF ST.LAWRENCE

1991-1992

COMMERCIAL SIZE FISH

1- NORDMORE GRATE ADAPTATION AND ASSESSMENT

2- SPLIT PANEL TRAWLNET FOR THE SEGREGATION OF FLATFISH FROM COD

3- MODEL DESIGN AND TESTING OF A SHRIMP SEPARATOR TRAWL

SELECTIVITY PROJECTS IN THE GULF OF ST.LAWRENCE

1991-1992

JUVENILE FISH

1- INCREASED MESH SIZE SELECTIVITY STUDIES FOR MOBILE GEAR

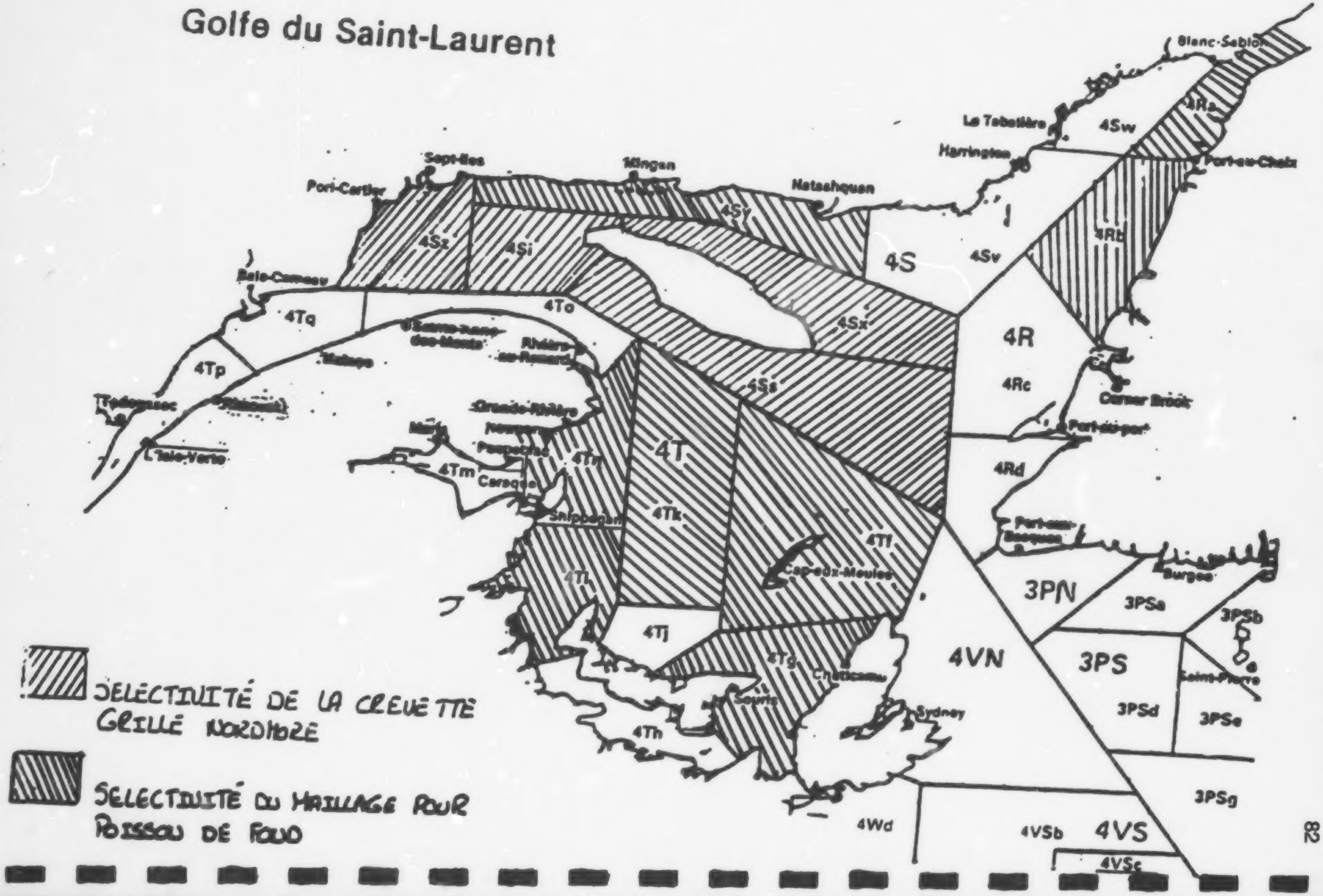
2- MID-WATER TRAWLING ASSESSMENT FOR SHRIMP FISHING

3- SMALL SCOTTISH SEINERS MESH SIZE PRELIMINARY ASSESSMENT

4- MESH SIZE SELECTIVITY ASSESSMENT FOR HAKE IN THE NORTHUMBERLAND STRAIT

5- AMERICAN PLAICE DIAMOND MESH SELECTIVITY STUDY

Golfe du Saint-Laurent


Blanc-Sablon
La Tabatière
Harrington
4Sw
4Ra
Port-au-Choix
4Rb
Natashquan
Mingan
Sept-Îles
Port-Cartier
4Sy
4Sz
4Si
4S
4Sv
Baie-Comeau
4Tq
4To
4Sx
4R
4Rc
Corner Brook
Sainte-Anne-des-Monts
Rivière-au-Renard
4Tp
Matane
4Ss
Tadoussac
Rimouski
Grande-Rivière
Newport
Port-au-Port
Maria
Paspébiac
4Tn
4T
4Rd
L'Isle-Verte
4Tm
Caraquet
Shippagan
4Tk
Port-aux-Basques
4Tf
Cap-aux-Meules
Burgeo
4Tl
3PN
3PSa
3PSb
4Tj
4Tg
Chéticamp
4VN
3PS
Saint-Pierre
Souris
Sydney
3PSd
3PSe
4Th
3PSg
4Wd
4VSb
4VS
4VSc
▨ SELECTIVITÉ DE LA CREVETTE GRILLE NORDMORE
▨ SELECTIVITÉ DU MAILLAGE POUR POISSON DE FOND

MESH SIZE SELECTIVITY STUDY FOR MOBILE GEAR IN THE GULF OF ST.LAWRENCE IN 1991

PROJECT COMPONENTS

1- Technical assessment of the mesh size taking into consideration nominal mesh dimensions of 130, 140 & 155 mm;

2- Mesh size selectivity factor assessment for each nominal dimension under scientific protocol;

3- Catch rate evaluation using each mesh dimension under commercial operations;

4- Economic impacts assessment on fleet sectors related to potential mesh size increase.

EXPERIMENTAL FLEETS

CATCH RATE ASSESSMENT

TRAWLERS 4T

Landing ports	Boats
NEWPORT (Que)	
	Annie-Claude
	Emeraude
	Yannick V

TRAWLERS 4S

RIVIERE AU RENARD (Que)	
	Sextant
	Soulaiedo

TRAWLERS 4R

PORT AUX CHOIX (Nfld)	
	Anna-Mildred
	Savage Foam

SEINERS 4T

CHÉTICAMP (N.S.)	
	Jean-Bernard
	Miss-Coop
LAMEQUE (N.B.)	
	Mars D

SELECTIVITY FACTORS ASSESSMENT

LAMEQUE (N.B.)	
	Iles Lamèque II
RIVIERE AU RENARD (Que)	
	Jonève

Mobile Gear Selectivity

Mesh Selectivity

FACTORS

✓ Size (dimension)

✓ Opening (shape)

✓ Twine size

✓ Twine type (knotted vs knottless)

✓ Gear speed

✓ Shrinkage

✓ Attachement devices

✓ etc.

MEAN MESH SIZE

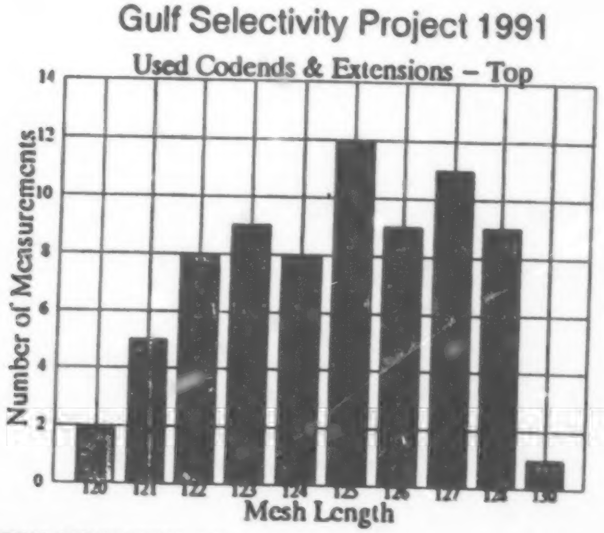
Total Tows: 18

TOP

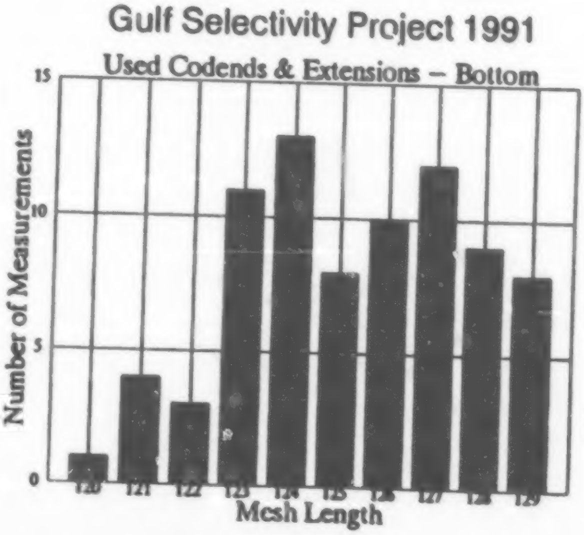
Vessel Name: Miss Co-Op	Type of Fishing: Scottish Seining	Codend: F1
Twine Diameter: Dbl 6 mm	Mesh Size: 130 mm	Extension:
Twine Diameter:	Mesh Size:	Date: Nov 6-7 91
Material: Polyethylene	Type of Guage: ICES	State of Codend: Wet
Mesh Length (mm) (A)	No. of Measurements (B)	Total (A x B = C)
120	2	240
121	5	605
122	8	976
123	9	1,107
124	8	992
125	12	1,500
126	9	1,134
127	11	1,397
128	9	1,152
130	1	130
	74	9,233
MEAN MESH LENGTH:	125	

BOTTOM

Vessel Name: Miss Co-Op	Type of Fishing: Scottish Seining	Codend: F1
Twine Diameter: Dbl 6 mm	Mesh Size: 130 mm	Extension:
Twine Diameter:	Mesh Size:	Date: Nov 6-7 91
Material: Polyethylene	Type of Guage: ICES	State of Codend: Wet
Mesh Length (mm) (A)	No. of Measurements (B)	Total (A x B = C)
120	1	120
121	4	484
122	3	366
123	11	1,353
124	13	1,612
125	8	1,000
126	10	1,260
127	12	1,524
128	9	1,152
129	8	1,032
1,245	79	9,903
MEAN MESH LENGTH:	125	


Gulf Selectivity Project 1991

Used Codends & Extensions – Top


Gulf Selectivity Project 1991

Used Codends & Extensions – Bottom

TOTAL MEAN MESH: 125

FRAMEWORK

MESH SIZE SELECTIVITY

MESH SIZE ASSESSMENT

REFERENCE MESH DIMENSION : 130mm

PARAMETERS	JONEVE	ILES LAMEQUE II
MESURING SPEC.		
Device:	Ices gauge	Ices gauge
Tension:	4kg	4kg
No. of data	366	448
MATERIEL		
Type:	Polyethylene	Polyethylene
Diameter:	Dbl 4mm and Dbl 6 mm	Dbl 4mm and Sin 6 mm
AVE. TOWING SPEED	2.6 knots	1.56 knots
(SPEED OF BOATS)		
AVE. TOWING TIME	1.81 h	0.84 h
TOTAL CATCH	8 415 kg	5 468.50 kg
BOTTOM TYPE	ROCKY	SANDY
No of fishing days:	7	7
UTILISATION PERIODS	45 DAYS	91 DAYS

MESH SIZE DURING EXPERIMENTS :	125.30 mm	125.48 mm
CORRELATED MESH SIZE :	135.28 mm	135.42 mm

Mesh size variations

1991 selectivity project

Gear Section	AVERAGE MESH SIZE (mm)			VARIATIONS IN SIZE	
	Nominal	New	Used	Max.	Min.
		TRAWNET			
Cod end	130	125.4	122.8	5.0	0.6
	140	133.9	132.3	4.0	-0.1
	155	149.5	148.2	3.5	-0.9
Extension	130	126.7	125.3	5.5	-0.4
	140	136.2	134.5	3.4	-0.2
	155	152.6	151.0	4.0	-2.4
		SEINE			
Cod end and extension	130	127.4	125.7	4.3	-5.4
	140	135.5	133.7	3.0	0.6
	155	153.1	150.6	4.2	1.8

Table 1

MEAN MESH SIZES\TRAWLERS, AREAS 4RST (7 units)

Reference mesh size (mm)	Nb of measurements	Mean mesh size* (mm)	Correlated mesh size** (mm)
130	2132	124.81	134.89
140	2112	134.45	142.51
155	2000	149.95	154.86

Table 2

MEAN MESH SIZE\Seiners, AREA 4T (3 units)

Reference mesh size (mm)	Nb of measurements	Mean mesh size* (mm)	Correlated mesh size** (mm)
130	1245	125.82	135.69
140	1048	136.00	143.74
155	1230	151.22	155.77

* ICES GAUGE (4Kg) DATA

** CORRELATED DATA TO THE CANADIAN FLAT WEDGE

EXAMPLE OF SELECTIVITY PARAMETER
(TROUSER GEAR ASSESSMENT)

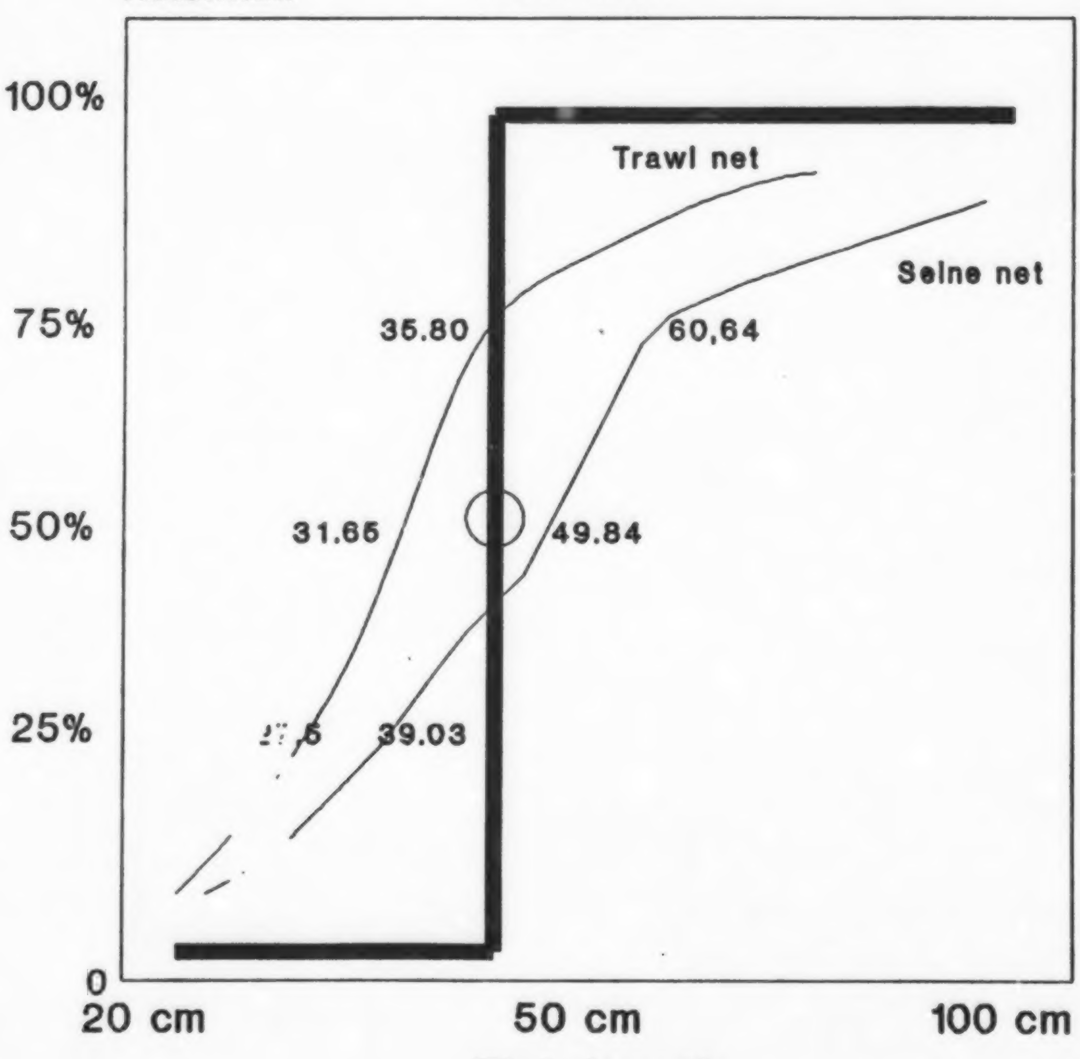
SELECTIVITY PARAMETER	TRAWL			SEINE		
Nominal mesh size	130 mm	140 mm	155 mm	130 mm	140 mm	155 mm
L 25	27.51 cm	40.64 cm	45.44 cm	39.03 cm	48.98 cm	69.61 cm
L 50	31.65 cm	45.50 cm	52.12 cm	49.84 cm	54.82 cm	76.80 cm
L 75	35.80 cm	50.36 cm	58.80 cm	60.64 cm	60.67 cm	83.99 cm
SELECTIVITY FACTORS	2.43	3.25	3.36	3.83	3.91	4.95

NOTE : THE TROUSER TRAWL USED FOR THE ASSESSMENT WAS RIGGED WITHOUT ANY ATTACHMENT DEVICE SUCH AS STRENGTHENING OR LASTRIDGE ROPE.

Magic

Mesh Size Selectivity Curves

130 mm



PERFORMANCE OF SPLIT PANEL TRAWL

Fishing gear configuration

Number of tows	Sweep line length (fms)	Doors spread (m)	Wings end spread (m)	Footrope spread (%)	Headline height (m)	Bridles angle (degree)	Panel height (m)	Depth (fms)	Towing speed (Knots)
2	20	76.2	19.5	52.0	4.11	22	1.2	54.5	2.75
4	30	89.8	19.9	52.3	3.92	22	1.2	57.5	2.73
3	30	92.6	20.3	53.6	3.46	23.3	0.9	67.3	2.6

GEAR TYPE :NOVA 402, 4 SEAMS NET, 135MM

BISON (JUNIOR) DOOR #11

ROCKUPPER FOOTGEAR

PERFORMANCE OF SPLIT PANEL TRAWL

Aggregated results of top and lower levels

SPECIES		TOP (%)		LOWER (%)		TOTAL AMOUNT OF FISH (Kg)
	PANEL HEIGHT(m)	1.2	.9	1.2	.9	
COD		94.15	98.25	5.85	1.75	2935.6
CRAB		0.00	0.00	100.0	100.0	72.6
FLOUNDER		0.00	0.00	100.0	100.0	460.5
EELS		20.63	0.00	79.37	100.0	33.0
SKATE		0.00	0.00	100.0	100.0	14.5

NOTE: The data was gathered when setting gear and during operation

Mobile Gear Selectivity

Atlantic Workshop

In the Gulf of St-Lawrence, selectivity projects are carried out *to achieve:*

- *Clean fish*eries

and to provide

- *Alternative tools for* responsible fishing

SCOTIA FUNDY REGION GEAR SELECTIVITY EXPERIMENTS

By

Chris Cooper
DFO, Halifax
and Industry Representative

SCOTIA FUNDY REGION GEAR SELECTIVITY EXPERIMENTS

Mr. C. Cooper (DFO): I just quickly wanted to run this overhead up to show that all the Atlantic regions have conducted experiments on shrimp graters. We started in 1990 and it has been followed by each of the other regions: Quebec, Gulf and Newfoundland in 1991.

We have had success with the grate as Joey has demonstrated. No real problems with using the grate.

The Quebec region has had the same sort of similar success in reducing the by-catch of other species.

There have been some problems in the Gulf region and in Newfoundland. I will briefly look at them a little bit later.

Just to highlight what kind of change you get from using the grate. These are the results of the experiments which were conducted in Scotia/Fundy. The first one is our research vessel the Lady Hammond. The second one is a commercial 65' vessel. If you look at the percents down at the bottom without the grate and with the grate, then you can see that we reduced the by-catch of groundfish from 47% down to 4.2%. On the commercial vessel, we got similar results, we went from 39% down to 1.7%.

The Gulf region did not have as much success. We have only witnessed one to two percent shrimp loss, but they were seeing a shrimp loss of 5-9 percent and a higher by-catch (mostly capelin).

But like our experience almost all the cod and redfish were excluded.

Some of the concerns that have been raised in the Gulf region is that it takes to long to handle the gear. It was 20 minutes when this mini-graph was made but I understand it is a closer to 10 minutes now. They have also found that the grate has become broken or bent which if you have to replace it while actually at sea in operation can be bothersome. Sometimes they have also found that there is twists occurring in front of the grate which blocks the grate and they lose their entire catch.

The Newfoundland region also conducted an experiment on the northern shrimp. They only did a few tows on it. But the first time they tried it one of the big problems was jellyfish blocking the grate.

On other tows that they used the grate they found that the codend become twisted in front of the grate; the same thing that was witnessed in the Gulf region. They anticipated that they would have difficulty handling the grate in the heavy ice. They felt that also for their particular shrimp fishery up in the northern waters, they would need a bigger bar spacing than the 19mm.

Roger has also mentioned a possible way of getting rid of the jellyfish problem which would be to utilize two grates; one on a lower angle with bigger bar spacing to get rid of the jellyfish and another standard grate to get rid of the by-catch. So maybe Newfoundland will try that concept next year.

Cod/Haddock Separator Trawl

That is about all I want to say on the Nordmore grate. I just want to quickly move on to another project that again you have heard a lot about. We call it the cod/haddock separator trawl.

The cod/haddock separator trawl has some real potential benefits in our region. We have quite a mixture of cod and haddock. Sometimes areas will be closed because we do not want to affect the haddock or maybe at some future date the cod resource would be low. Using a separator trawl is potentially one way of keeping areas open to fishermen and they just harvest either the bottom or the top of the trawl.

We have done our trials with two trawls that we have had modified with horizontal panels. We used double codends, one for the top panel and one for the bottom, and then we just counted the number of fish in each codend.

We had some difficulty getting the separator trawl to work initially and Bill had to do quite a few modifications to the trawl at sea. Finally, in our last cruise in 1991 we had some very promising results.

I know there is a lot of numbers in this particular table, but I think it is worth going through it in a little bit of detail because it does illustrates some of the important points of what you can achieve with these trawls.

If you go over to the column called panel height, the second column from the left that represents the height at which the panel is above the footrope; at least the height at which the ropes are measured above the footrope. And you can see we tried four different heights there going from 2.5' up to 4'.

And then the figures across under the various species at the top and bottom represent the percentage in terms of number of fish in the top and bottom codends or the top and bottom of the panel.

The point I would like you to note is that for the haddock, once we got this panel working, the percentage in the top was fairly consistent no matter if we went 2.5' or 4'; it went from 96% down to 90%. It was a loss of 6% or so, but not a great loss. Whereas the cod caught in the bottom increased from 27% up to 58%. So we feel fairly confident this trawl is now working.

But there are other potential things that we could do with these type of trawls that we are looking at. As a result of keeping records on all the fish, we see some potential in other areas. One of them you already heard about from the Gulf region which is using a separator trawl to separate cod and flatfish. If you look at the flatfish, American plaice, yellowtail and winter flounder in our results, you will see that by and large, all the flounder is in the bottom where you would expect it to be. And we are getting a percentage of cod, at least at the panel height of 2.5; we are getting up to 70% of the cod up top. So our results tend to support what the Gulf have found that we can get some separation of flatfish and cod.

Other things that I have found interesting to note is the fact that you have halibut, particularly some of the big halibut, going to the top side as opposed to staying in the bottom.

Finally, just to summarize our work on the cod/haddock separator trawl, we did have some difficulties setting it up. So it is not going to be something that we just give to fishermen and say, "Go and do it". There is going to be some fine tuning required. For that reason, I do not think it is ever going to be an item that can be regulated. However, in this region, I do not think it is going to be a problem because we already got fishermen coming forward and saying, "Well, I'd like to try this in my fishery because my quota of cod is out, but I'd like to go flatfish fishing and do not want to discard cod".

Another point we have found which I did not expect was that there was no difference in the size of fish that went in the top panel from those that went in the bottom panel. I had anticipated that there would have been some difference according to their size, that the big fish would go up top and the smaller fish would stay on the bottom. But we did not find that difference.

As I have pointed out before, at least for the cod and haddock results, once we got the separator panel working it did not vary significantly with panel height.

I have mentioned applications to other species. In this region, we are still in the experimental stage. We do not figure we have something that we can regulate or anything like that. But we have progressed in the experimental stage so that our next step is going to be that we want to go out to industry, give them some of these panels and see what they can do with it. I think that this will probably be the most interesting stage.

Finally, what are we going to be doing next year? And I just thought I would run through the sort of projects we have submitted for approval.

1.0 Cod/Haddock Trawl

I already mentioned the cod/haddock separator trawl. Hopefully we will get approval of that.

2.0 Sortex

The offshore Sortex project with National Sea. We have got the Sortex gear, hopefully we will get some funding to proceed with that with National Sea.

3.0 Harbour Porpoise

The harbour porpoise depth of dive study. We started last year, we want to complete it this year. We actually missed the August window last year. There is a very short window when we can capture live animals.

4.0 Silver Hake

I was considering the separator panel for the separation of silver hake from other species, but I might twist this project a little bit in light of what the fishermen are saying now about using grates and try and use a grate to separate silver hake from other species and perhaps even separate out the small silver hake.

5.0 Danish Seiner Selectivity Expt.

Selectivity experiment for Danish seiners. We already have heard from several speakers that the Danish seiners feel like they should have a different mesh size from the trawlers. Hopefully we can do some experiments this coming year that will actually show the selectivity. What we did last year was only demonstration experiments. To do selectivity we need to use small mesh control codends.

6.0 Shrimp Sizing Grate

A project that we had in last year but because we missed the shrimp season we were not able to pursue was to follow up with some work that has been done in Norway in trying to size the shrimp in the trawl before you bring it up top. We would like to pursue that because quite a few of the shrimp are on the small side and there is quite a handsome benefit to be paid to the fishermen if they are bringing in just the larger shrimp.

7.0 Longline Bait Size Study

Following on from the longline selectivity study of hook size, it is being proposed that one of the major impacts on selectivity with the longlines is bait size. It is something that we have not done an awful lot of in this region, so we proposed the project to look at the impact of bait size on the selectivity of different hooks.

8.0 Lost Gill Net

And finally, a project that again was initiated by industry. Some of the newer side scan sonars appear to be capable of picking up gill nets, particularly the lead line on gill nets. We did one simple trial, or actually Science Branch did one simple trial last year on a very smooth bottom where they easily identified a lost gill net using side scan sonar. We want to do a little project where we try it on a few more different bottoms which are harder to identify to see whether we can pursue this as an option for identifying lost gill nets.

That concludes my presentation and I would like to thank you all very much for your attention.

Gear Projects Scotia Fundy
1990

1. Silver Hake - 45 Foot and 65 Foot Vessels
2. Sea Cucumber - Scallop Drags
3. Shrimp Separator Nordmore Grate
4. Gill-Nets - Survey for Lost Nets
   - Long Term Study
5. Swordfish - Hook Size Study
6. Nat. Sea Products- Mesh Size Change
7. Separator Panel - Cod and Haddock
8. Introduction of Square Mesh

Scotia-Fundy Region
1991 Projects

1. Sortex System for Offshore

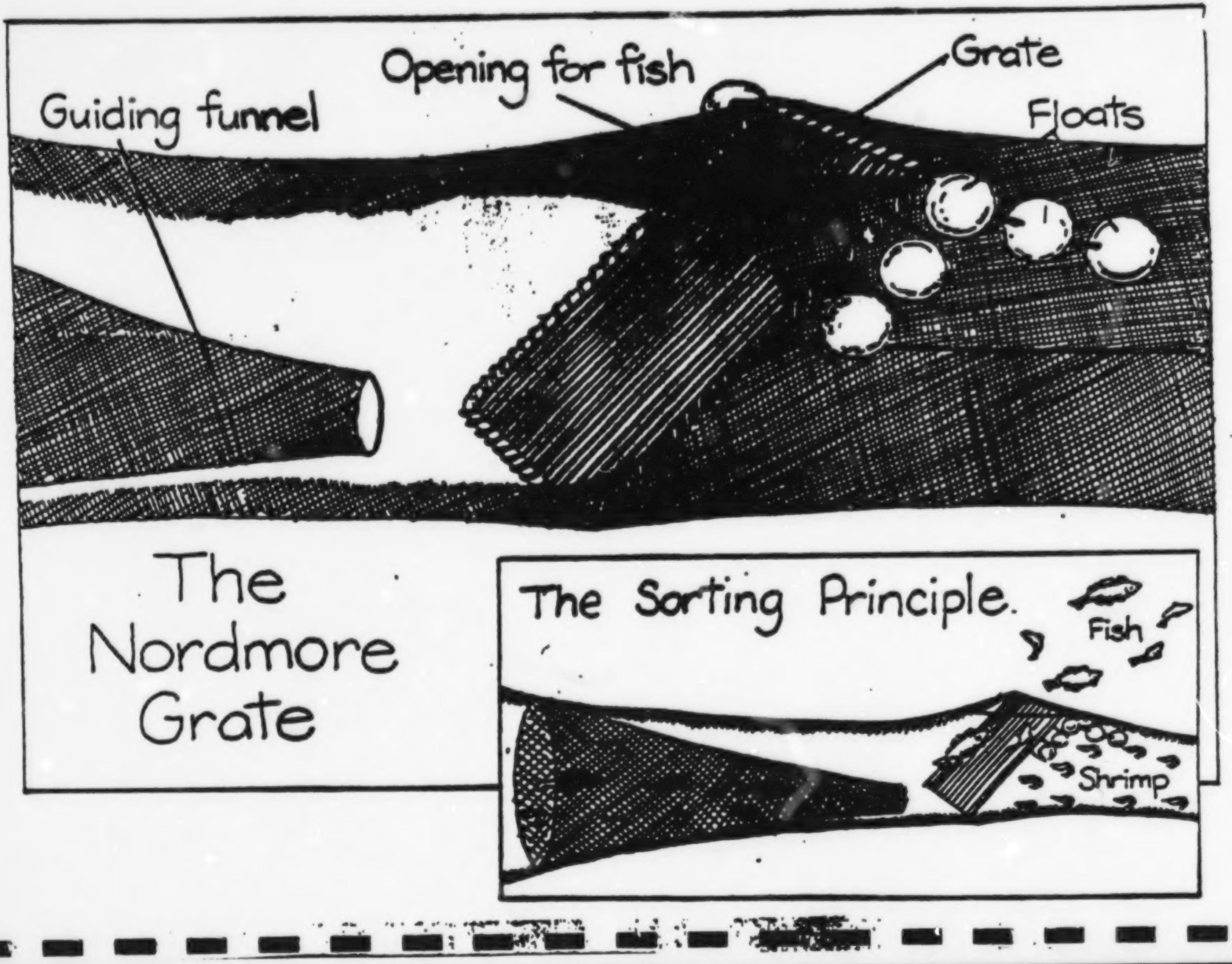
2. Cod/Haddock Separator Trawl

3. Longline Hook Size Experiment

4. Danish Seine Square Mesh Experiment

5. Harbour Porpoise Depth of Dive Study

6. Silver Hake Harvesting with Inshore Vessels



The Nordmore Grate

Guiding funnel
Opening for fish
Grate
Floats
The Sorting Principle.
Fish
Shrimp

NORDMORE GRATE

1990 Scotia-Fundy Region

- experiments with trouser trawl
- Research Vessel and Commercial Vessel (65'

1991 Quebec Region

- 6 vessels tested grate
- used standard shrimp trawl with bag over release hole

1991 Gulf Region

- 5 vessels tested grate (55' -74')
- a) used a 40 mm bag over release hole
- b) used a 130 mm bag over release hole

1991 Newfoundland Region

- one northern shrimp vessel
- a) retainer bag over hole (1 tow)
- b) alternate haul

Scotia–Fundy Region

Nordmore Grate

Lady Hammond July 1990

	Without Grate		With Grate	
	Shrimp	Grdfish	Shrimp	Grdfish
Weights (kg)	1994	950	1949	81
Percents	52.4	47.6	95.8	4.2

Leading Lady Aug 1990

	Without Grate		With Grate	
	Shrimp	Grdfish	Shrimp	Grdfish
Weights (kg)	2922	1141	3211	54.5
Percent	60.9	39.1	98.3	1.7

Quebec Region
Nordmore Grate Experiments

	Catch (kg)	2nd Codend (kg)	Percent of Catch
Shrimp	41,056	870	2.11
Cod	8,768	8,767	99.9
Redfish	4,800	4,288	89.3
Turbot	2,720	2,591	95.3
Grey Sole	98	70	71.4

126 Valid Sets with 6 Vessels

NEWFOUNDLAND REGION

Northern Shrimp

- Jellyfish blocking the grate
- codend twisted in front of grate
- handling difficulties in heavy ice
- loss of the larger shrimp with 19 mm bar spacing

Example Tows (Kg)

	Regular Codend	Separator Grate
Cod	119	‹ 1
Redfish	86	‹ 1
Turbot	60	6
A Plaice	41	2
Halibut	4	-

GULF REGION

Shrimp Grate

- Shrimp Loss 5.8 %
- Capelin – 65% went thru grate
- Almost all Cod and Redfish Excluded

CONCERNS

- Takes 20 min longer to retrieve trawl
- Grate becomes broken or bent
- Twists occur in Front of Grate

Cod/Haddock Separator Trawl

- 4 Cruises
  2 Research Vessels
  2 Chartered Commercial Vessels
- Two Trawls Modified to accept horizontal
  Panel
  Double Codend
- Experiments consisted of counting numbers of each species in each codend
- Initial cruises directed at familiarization with trawls and making mods. ~~R~~UCV
- Last Cruise aboard PRINCE varied heights Sytematically

Tow No	Panel Height	Haddock Top	Haddock Bottom	Cod Top	Cod Bottom	Pollock Top	Pollock Bottom	Silver Hake Top	Silver Hake Bottom	American Plaice Top	American Plaice Bottom	Yellowtail Top	Yellowtail Bottom
Separator Trawl on Prince Oct 1991													
1 to 11	2.5	96.01	3.99	72.59	27.41	100.00	0.00	52.00	48.00	3.13	96.88	5.58	94.42
12 to 21	3	92.94	7.06	55.08	44.92	100.00	0.00	42.11	57.89	2.78	97.22	5.71	94.29
22 to 29	3.5	88.86	11.14	47.23	52.77	99.62	0.38	41.67	58.33	0.00	100.00	2.99	97.01
30 to 33	4	90.19	9.81	41.05	58.95	99.86	0.14	17.65	82.35	0.00	0.00	2.53	97.47

Tow No	Panel Height	Winter Flounder Top	Winter Flounder Bottom	Halibut Top	Halibut Bottom	Sculpin Top	Sculpin Bottom	Skate Top	Skate Bottom	Mackeral Top	Mackeral Bottom	Herring Top	Herring Bottom
1 to 11	2.5	20.54	79.46	100.00	0.00	4.17	95.83	1.22	98.78	100.00	0.00	0.00	0.00
12 to 21	3	6.49	93.51	61.54	38.46	4.35	95.65	32.69	67.31	100.00	0.00	99.68	0.32
22 to 29	3.5	2.78	97.22	0.00	100.00	9.09	90.91	0.00	100.00	100.00	0.00	95.31	4.69
30 to 33	4	5.05	94.95	75.00	25.00	20.00	80.00	0.00	100.00	99.39	0.61	100.00	0.00

Proposed Projects for 1992
Scotia-Fundy Region

1.0 Cod/Haddock Separator Trawl

2.0 Testing of Sortex Grate

3.0 Harbour Porpoise Depth of Dive

4.0 Silver Hake

5.0 Danish Seiner Selectivity Experiment

6.0 Shrimp Sizing Grate

7.0 Longline Bait size Study

8.0 Side Scan Sonar for Lost Gillnets

OFFSHORE OTTER TRAWL SELECTIVITY STUDIES FOR COD

PRELIMINARY RESULTS

By

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DFO

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Manager, Resource Development
FPI

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INTRODUCTION

With recent quota reductions in fish stocks, especially the northern cod stock, there has been an even more increasing need to identify methods to better conserve and ultimately enhance the viability of such stocks to their fullest potential.

One such way to conserve and enhance the fish stock would be to ensure that the juveniles of the species have a better chance to survive the commercial fishery and grow to a size that would provide a better return. In the otter trawl fishery, this could be achieved through changes in the mesh size or shape or the rigging of the trawl to enhance selectivity.

Much work has been done on otter trawl selectivity in eastern Canada and Europe. However, viewpoints vary as to the impact various selectivity methods have on large concentrations of fish. Commercial fishermen and fisheries managers need to know, with a reasonable degree of certainty, the impacts of such changes on selectivity/escapement.

The Department of Fisheries and Oceans (DFO), in cooperation with Fishery Products International (FPI), have been carrying out mobile gear selectivity studies during the past two years. The purpose of the studies is to determine the most appropriate method of operating or rigging a groundfish otter trawl to reduce the catch of juvenile groundfish, in particular cod.

The M/V "Zandvoort", a 170' stern trawler owned and operated by FPI, was used during January and February, 1992 and carried out four different experiments. They were as follows:

1. To compare the selectivity characteristics of a regular codend to a codend with lastridge ropes shortened by 20%.
2. To compare the selectivity characteristics of a regular codend to a codend with the lastridge ropes shortened by 15%.
3. To compare the selectivity characteristics of 130mm square mesh codend to a 145mm diamond mesh codends.
4. To investigate the effectiveness of using a Sort-X system in an otter trawl to reduce the catch of juvenile cod fish.

METHODOLOGY

The vessel's traditional otter trawl, a 154'8" hi-rise groundfish trawl (Figure 1 & 2) was used during the four experiments. Modifications were made to the trawl to incorporate the various selectivity devices. Three different types of tests were conducted during the experiments; (1) Direct comparisons of two experimental codends using a trouser trawl (Figure 3 & 4; (2) use of a small mesh codend to obtain population samples while using an experimental codend; (3) use of small mesh retainer bag over a Sort-X system and small mesh codend to retain total catch.

During the first three experiments, a vertical divider panel (Figure 5) and trouser codends were installed. Codends were alternated several times to offset unequal splitting of the catch by the trouser trawl.

Two representatives from the Department of Fisheries and Oceans accompanied the vessel on the trip; one from Science Branch and one from Fisheries and Habitat Management Branch. The two DFO representatives ran separate 12-hour watches. One crew member was designated to assist the DFO representative during each watch.

All sets were carried out in depths ranging from 445 meters up to 834 meters. The duration of each set varied between 20 minutes and 1 hour 20 minutes.

Sampling

A random sample of 200 to 500 cod fish were collected from each codend from each successful set and the fork length of each fish was measured. A successful set was defined as one in which there was no damage to the trawl and sufficient cod were caught in each codend to provide an adequate sample.

Samples were obtained in two ways. When the temperature was mild (above 0^0 C)the codend with the smallest catch was put down the ramp first. A sample was obtained and the remainder of the catch was cleaned, boxed and iced in the hold. The discards were placed in separate pens and estimated before they were disposed overboard. The second codend was then discharged down the ramp and the same sampling process was repeated. To check for accuracy, the combined estimates for the two codends were compared to the weight of iced fish plus the discard weight.

The total number of fish was obtained by multiplying the number of fish in the sample by a factor obtained by division of the estimated total weight by the sample weight.

Experiment # 1 - To compare the selectivity characteristics of a regular codend to a codend with lastridge ropes shortened by 20%.

The vessel's traditional otter trawl was modified to accommodate twin codends and a 44mm vertical divider panel which extended from the headrope and footrope to the trouser codends (Figure 6). The first four sets were made with a 135mm diamond mesh in each side of the twin codends to determine if the trawl was being divided equally by the vertical panel and if codends with the same mesh sizes resulted in similar fish distribution. The following four sets were made to compare a 135mm diamond mesh codend with regular lastridge ropes to a 135mm diamond mesh codend with lastridge ropes shortened by 20%. The final three sets were made to compare the 135mm diamond mesh codend with shortened lastridge ropes to a 44mm diamond mesh liner in the codend with regular lastridge ropes.

Experiment # 2 - To compare the selectivity characteristics of a regular codend to a codend with the lastridge ropes shortened by 15%.

The same otter trawl with the 44mm vertical panel was used as in the previous experiment. Six successful sets were made using a 135mm diamond mesh codend with lastridge ropes shortened by 15% on one side of the trouser compared to a 44mm mesh liner in the control codend on the other side. Each set was monitored similar to the previous experiment.

Experiment # 3 - To compare the selectivity characteristics of 130mm square mesh codend to a 145mm diamond mesh codends.

The same otter trawl with the 44mm vertical panel was used as in the first two experiments. The first 7 successful tows were made using a 130mm square mesh codend (Figure 7) compared to a 44mm mesh control codend. The remaining 8 tows were made using a 145mm diamond mesh codend compared to a 44mm mesh liner in the control codend.

Experiment # 4 - To investigate the effectiveness of using a Sort-X system in an otter trawl to reduce the catch of juvenile cod fish.

The same otter trawl with the vertical panel removed was used. A 44mm mesh retainer bag was attached to the fish escapement opening of the Sort-X system (Figure 8 & 9). The codend was also lined with 44mm mesh. Eight successful sets were made. Random samples were taken from the codend and the retainer similar to the other experiments.

RESULTS

Experiment # 1

A total of seventeen sets were made; 11 of which were successful. The first four sets indicated that the length frequency distributions of the two codends were similar. The next four sets showed that the codend with the 20% shortened lastridge rope caught fish which averaged from 2.16 cm to 6.2 cm longer than the codend with the regular lastridge ropes (Table 1)(Figure 10). Approximately 1.2% to 4.4% of the fish retained in the 20% shortened lastridge rope codend were under 43cm, while 3.4% to 18.2% of the fish retained in the codend with regular lastridge ropes were under 43cm.

During the remaining three sets, only 0% to 0.7% of the fish retained in the 20% shortened lastridge rope codend were under 43 cm, while 15% to 47.2% of the fish retained in the 44mm liner in the control codend were under 43cm (Table 2) (Figure 11). These calculations are based on numbers of fish.

During the 11 successful sets, a total of 141232 kg of cod were caught. Catch rates per set varied from 1591 kg to 21777 kg. The shortened lastridge rope codend retained very little fish under 43cm in both large and small sets. All weights are round weights.

TABLE 1: SUMMARY OF RESULTS

Comparisons of 135mm mesh diamond codend to a 135mm mesh diamond codend with lastridge ropes shortened by 20%.

SET #	CODEND #	# FISH	LENGTH RANGE (cm)	AVERAGE LENGTH/FISH (cm)	TOTAL CATCH (kg)	AVERAGE WEIGHT OF FISH (kg)	% OF FISH UNDER 43 cm
5	1	3951	37-76	52.90	4546	1.15	3.4
	3	1984	37-83	55.73	3000	1.51	1.2
6	1	13942	32-73	48.03	14288	1.02	18.2
	3	2337	36-78	54.23	3560	1.52	2.0
7	1	3560	31-75	48.95	3849	1.08	14.1
	3	1018	38-76	54.47	1342	1.32	2.2
8	1	13347	28-71	45.54	11591	0.87	11.8
	3	2210	39-73	51.44	2836	1.28	4.4

TABLE 2: SUMMARY OF RESULTS

Comparisons of 135mm mesh diamond codend with 20% shortened lastridge ropes and 44mm mesh liner in the codend.

SET #	CODEND #	# FISH	LENGTH RANGE (cm)	AVERAGE LENGTH/FISH (cm)	TOTAL CATCH (kg)	AVERAGE WEIGHT OF FISH (kg)	% OF FISH UNDER 43 cm
9	3	3037	43-74	57.14	5182	1.71	0
	5	19237	28-71	45.29	15818	0.82	40.6
10	3	2076	42-80	56.52	3491	1.68	0.7
	5	24779	20-74	43.42	18286	0.74	47.2
11	3	4329	42-75	55.22	6927	1.60	0.4
	5	14832	28-71	45.39	12730	0.86	15.8
TOTAL		41,381			141,232		

Key: Codend # 1 = 135 mm diamond mesh
Codend # 3 = 135 mm diamond mesh with lastridge ropes shortened by 20%
Codend # 5 = 145 mm diamond mesh with 44 mm mesh liner

Experiment # 2

Six successful sets showed that the 135 mm diamond mesh codend with lastridge ropes shortened by 15% caught fish with average length between 5.46 cm and 9.7 cm longer than those caught in the 44 mm mesh liner in the control codend (Table 3)(Figure 12). Approximately 0% to 2.94% of the fish retained by the shortened lastridge rope codend were under 43 cm, while between 9.1% and 23.24% of the fish retained in the 44 mm mesh liner in the control codend were less than 43 cm in length.

During the six successful sets, a total of 75,070 kg of cod were caught. Catch rates per set varied from 370 kg up to 16,665 kg. All weights are round weights.

TABLE 3: SUMMARY OF RESULTS

Comparisons of a 135mm mesh diamond codend with lastridge ropes shortened by 15% versus a 44mm mesh liner in the control codend.

SET #	CODEND #	# FISH	LENGTH RANGE (CM)	AVERAGE LENGTH/FISH (CM)	TOTAL CATCH (KG)	AVERAGE WEIGHT OF FISH (KG)	% OF FISH UNDER 43 CM
1	4	2342	36-73	54.30	3573	1.53	2.32
	5	7958	35-78	47.94	7560	0.95	22.19
2	4	9479	38-78	53.75	13243	1.40	2.94
	5	15785	33-68	48.29	16665	1.06	15.54
3	4	803	45-85	57.27	1527	1.90	0
	5	4751	30-73	51.27	5279	1.11	9.91
4	4	212	42-74	56.55	370	1.75	0.47
	5	1092	31-71	47.66	1098	1.01	23.24
5	4	1353	40-77	56.22	2078	1.54	1.01
	5	9118	33-75	46.52	9745	1.07	17.5
6	4	2139	40-74	54.77	3273	1.53	0.57
	5	10659	35-67	48.16	10659	1.00	19.47
TOTAL		65691			75070		

Key: Codend # 4 = 135 mm mesh codend with lastridge ropes shortened by 15%.
Codend # 5 = 145 mm diamond mesh with 44 mm mesh liner.

Experiment # 3

A total of 24 sets were made; 15 of which were successful. The first seven sets showed that the 130mm square mesh codend caught fish which averaged between 2.67 cm to 12.47 cm longer than those caught in the 44mm mesh control codend (Table 4)(Figure 13). Approximately 1.7% to 32.8% of the fish retained by the square mesh codend were under 43 cm while between 25.4% and 68.5% of the fish retained by the 44 mm mesh control codend were less than 43 cm. The remaining eight success sets showed that the 145 mm diamond mesh codend caught fish with an average length from 5.73 cm to 12.4 cm longer than those caught in the 44 mm mesh liner in the codend (Table 5)(Figure 14). Approximately 0.52% to 6.95% of the fish retained by the 145 mm mesh liner in the codend were under 43 cm, while between 11.42% and 32.9% of the fish retained by the 44 mm mesh liner in the control codend were less than 43 cm. These calculations are based on numbers of fish.

During the 15 successful sets, a total of 149355 kg of cod was caught. Catch rates varied from 1060 kg to 20310 kg. All weights are round weights.

TABLE 4: SUMMARY OF RESULTS

Comparisons of a 135mm square mesh codend versus a 44mm mesh control codend.

SET #	CODEND #	# FISH	LENGTH RANGE (CM)	AVERAGE LENGTH/FISH (CM)	TOTAL CATCH (KG)	AVERAGE WEIGHT OF FISH (KG)	% OF FISH UNDER 43 CM
1	6	2037	33-75	46.15	1782	0.87	32.8
	5	13882	29-58	41.50	8479	0.61	68.5
2	6	3853	34-74	49.93	4364	1.13	11.8
	5	14012	32-69	47.26	13636	0.97	25.4
3	6	479	39-81	54.17	682	1.42	1.8
	5	2149	33-80	46.47	2045	0.95	30.1
4	6	1464	35-71	50.21	1636	1.12	9.8
	5	19462	30-68	42.32	13636	0.70	55.7
5	6	3136	37-77	52.43	4036	1.29	6.9
	5	10003	29-72	45.23	8594	0.86	38.6
6	6	589	39-77	54.71	886	1.50	1.7
	5	8042	26-66	42.24	5744	0.71	56.7
7	6	1196	34-67	50.27	1511	1.26	14.3
	5	13484	30-69	42.45	9246	0.69	55.5

Key: Codend # 5 = 145 mm diamond mesh with 44 mm mesh liner
Codend # 6 = 130 mm square mesh

TABLE 5: SUMMARY OF RESULTS

Comparisons of a 145mm mesh diamond codend versus a 44mm mesh control codend.

SET #	CODEND #	# FISH	LENGTH RANGE (cm)	AVERAGE LENGTH/FISH (cm)	TOTAL CATCH (kg)	AVERAGE WEIGHT OF FISH (kg)	% OF FISH UNDER 43 cm
8	8	211	39-86	56.72	418	1.98	0.95
	5	1314	31-66	47.33	1542	1.17	23.2
9	8	384	41-81	59.08	697	1.82	0.52
	5	5945	34-70	47.76	6606	1.11	24.9
10	8	442	41-89	57.82	792	1.79	0.90
	5	8973	28-71	45.42	7662	0.85	32.9
11	8	1715	37-83	56.95	3331	1.94	1.28
	5	17158	32-68	47.38	16979	0.99	21.88
12	8	954	37-82	53.69	1306	1.37	6.22
	5	7036	31-76	46.22	6321	.90	32.2
13	8	1237	36-75	55.83	2045	1.65	2.04
	5	8321	34-73	48.62	9435	1.13	18.5
14	8	403	38-69	52.66	569	1.41	6.95
	5	1893	34-70	46.38	1739	0.92	25.7
15	8	1684	37-82	54.17	2727	1.62	2.26
	5	9428	32-66	48.44	10909	1.15	11.42
TOTAL		160886			149,355		

Key: Codend # 5 = 145mm diamond mesh with 44mm mesh liner
Codend # 6 = 130mm square mesh
Codend # 8 = 145mm diamond mesh

Experiment # 4

Eight successful sets showed that the 44 mm mesh liner in the codend used with the Sort-X system caught fish with an average length between 3.88 cm and 5.91 cm longer than those caught in the retainer bag (Table 6)(Figure 15). From 12.5% to 32.25% of the fish retained by the 44 mm codend were under 43 cm, while from 38.62% to 61.24% of the fish in the retainer hag were under 43cm. These calculations are based on numbers of fish.

During the 8 successful sets, a total of 138964 kg of cod were caught. Catch rates per set varied from 1206 up to 25489 kg. All weights are round weights.

TABLE 6: SUMMARY OF RESULTS

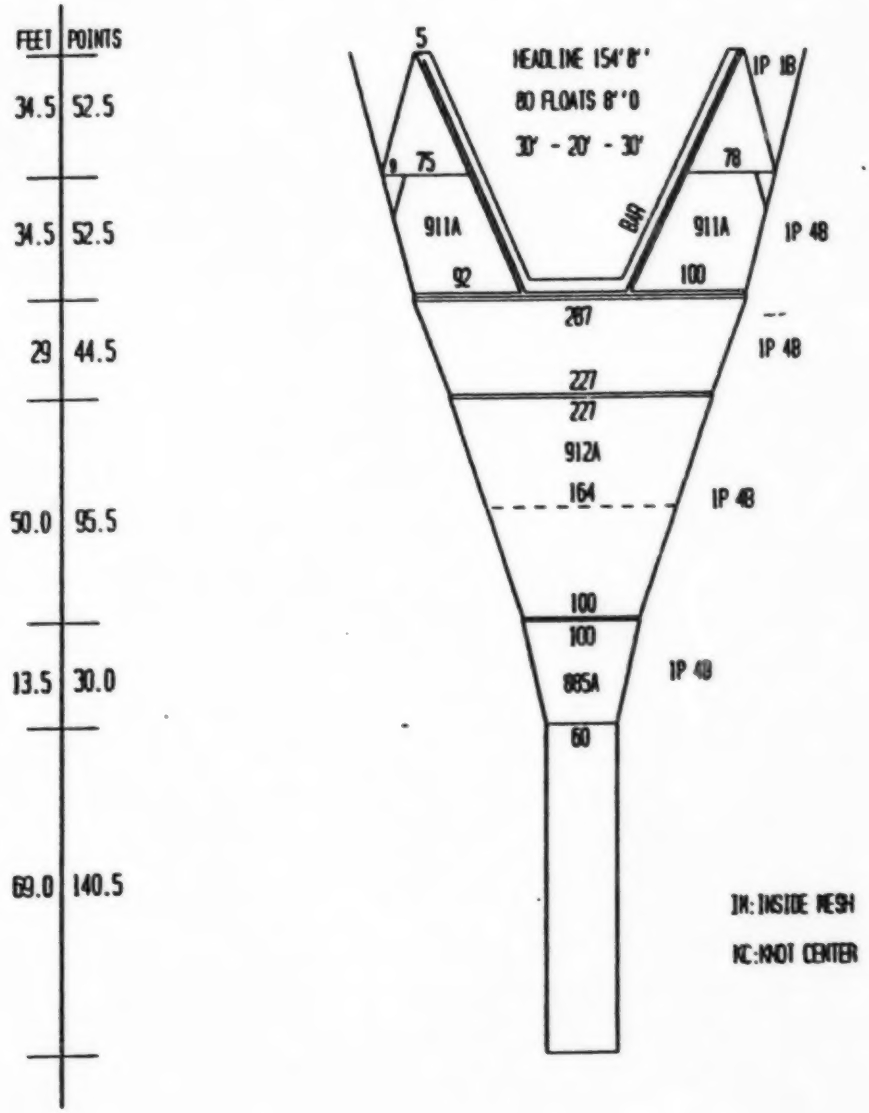
Comparisons of a Sort-X system codend with 44mm mesh and 44mm retainer bag of 44mm mesh.

SET #	CODEND #	# FISH	LENGTH RANGE (CM)	AVERAGE LENGTH/FISH (CM)	TOTAL CATCH (KG)	AVERAGE WEIGHT OF FISH (KG)	% OF FISH UNDER 43 CM
1	R.B.	4389	32-57	44.06	3637	0.83	38.62
	5	18297	35-85	48.59	19861	1.09	16.33
2	R.B.	3231	31-51	42.72	2232	0.69	46.67
	5	8464	37-69	48.21	8213	0.97	16.44
3	R.B.	1886	30-54	42.63	1239	0.66	50.14
	5	4058	34-65	47.16	3672	0.90	19.94
4	R.B.	4936	27-56	42.69	3336	0.68	47.49
	5	11619	33-69	48.60	11368	0.98	12.50
5	R.B.	7889	31-53	42.67	5537	0.70	48.02
	5	20714	35-69	46.55	18971	0.92	20.30
6	R.B.	2030	31-55	41.55	1206	0.59	61.24
	5	5067	31-69	45.54	4462	0.88	34.25
7	R.B.	8058	32-56	41.88	5059	0.63	56.10
	5	22011	32-74	47.36	18995	0.86	24.49
8	R.B.	8780	33-57	42.88	5687	0.65	45.17
	5	27166	34-75	47.83	25489	0.94	18.27
TOTAL		158595			138964		

Key:			
Key:	Codend #4	=	135mm mesh codend with lastridge ropes shortened by 15%.
	Codend #5	=	145 diamond mesh with 44mm mesh liner.
	R.B.	=	Retainer bag of 52mm mesh to catch fish escaping from Sort-X.

CONCLUSIONS

1. The results of these experiments indicate that (1) 20% and 15% shortened lastridge roped codends, square mesh codends and 140 mm dia. mesh codends release a high percentage of the fish under 43 cm.
2. Square mesh codends are prone to knot slippage and subsequent mesh distortion. This seems to be accelerated by very large catches.
3. Short lastridge rope codends offer more advantages from a handling and maintenance perspective than square mesh codends. Therefore, future attempts at finding an effective means of releasing small fish should concentrate on this method.
4. Sort-X system results did not indicate that this system was effective in reducing the catch of juvenile fish. It is believed that the Sort-X system's effectiveness may be reduced by fish density.
5. Time constraints make it very difficult to get an adequate number of tows for several experiments. Future efforts should concentrate on one experiment per trip or per two trips if this is necessary to get the required number of tows.

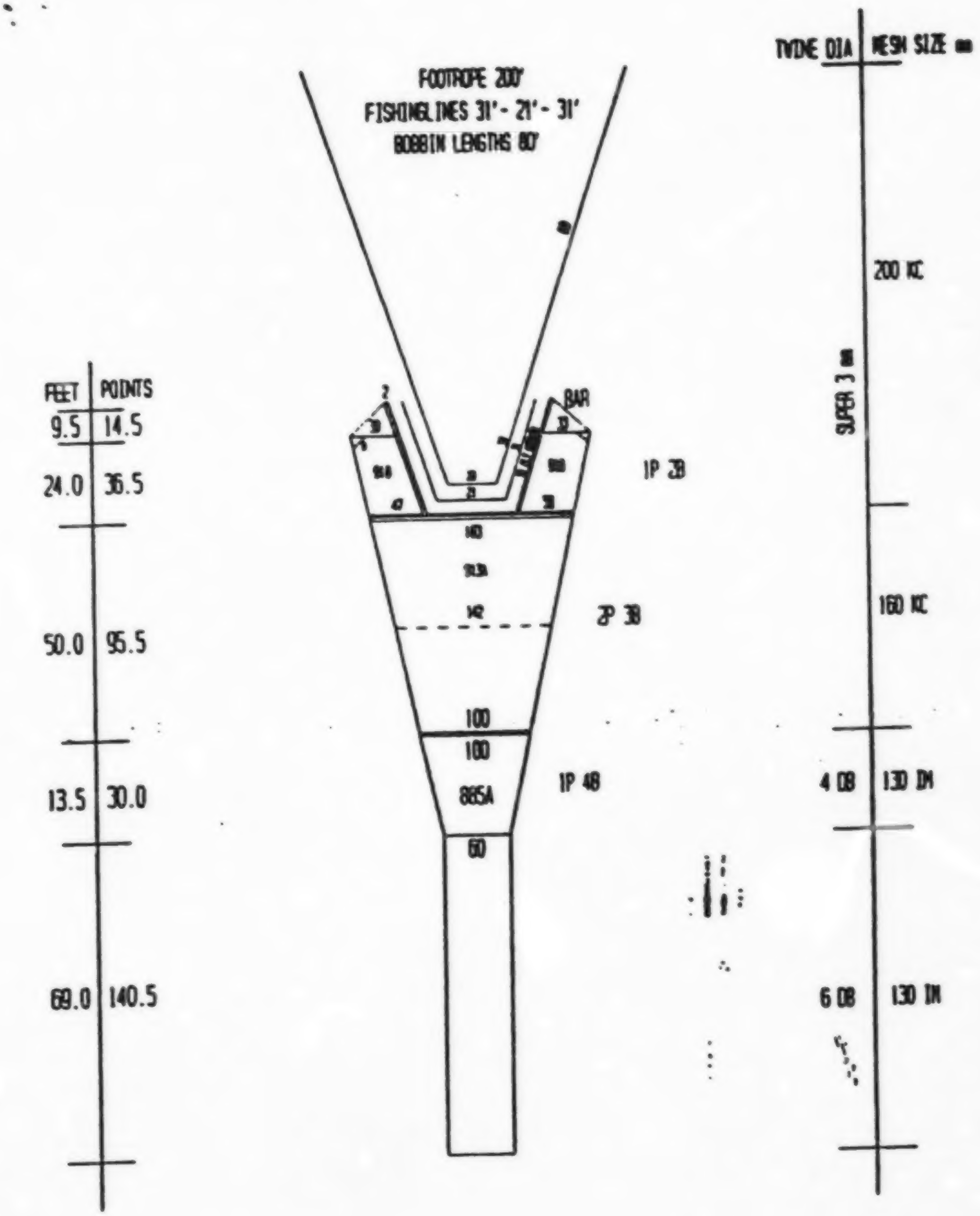

FEET
POINTS
34.5 52.5
34.5 52.5
29 44.5
50.0 95.5
13.5 30.0
69.0 140.5
5
HEADLINE 154'8''
80 FLOATS 8''0
30' - 20' - 30'
IP 1B
9
75
78
911A
BAR
911A
IP 48
92
100
287
IP 48
227
227
912A
164
IP 48
100
100
885A
IP 48
60
IM: INSIDE MESH
KC: KNOT CENTER

FISHERIES & OCEANS
FISHERIES DEVELOPMENT DIVISION
NEWFOUNDLAND REGION

HAMPIDJAN
HI-LIFT TRAWL

DRAWN BY: LUKE HOGAN
DATE : FEBRUARY 7, 1991
SCALE : SHOWN ON LEFT
DRAWING NO. :

Figure 1

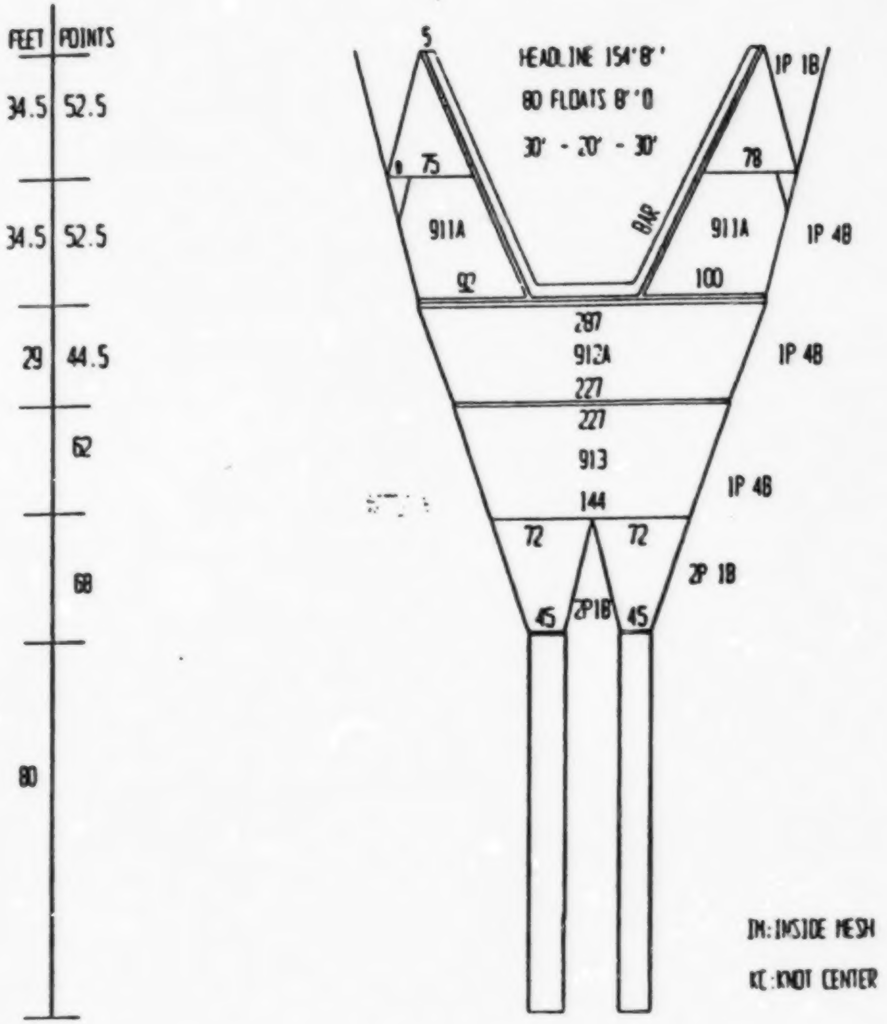

FOOTROPE 200'
FISHINGLINES 31' - 21' - 31'
BOBBIN LENGTHS 80'
FEET | POINTS
9.5 | 14.5
24.0 | 36.5
50.0 | 95.5
13.5 | 30.0
69.0 | 140.5
2
BAR
38
918
47
21
38
143
91.5A
142
100
100
865A
60
1P 28
2P 38
1P 48
TWINE DIA | MESH SIZE mm
200 KC
SUPER 3 mm
160 KC
4 DB | 130 DM
6 DB | 130 IN

FISHERIES & OCEANS
FISHERIES DEVELOPMENT DIVISION
NEWFOUNDLAND REGION

HAMPIDJAN
HI-LIFT TRAWL

DRAWN BY: LUKE HOGAN
DATE : FEBRUARY 7, 1991
SCALE : AS SHOWN
DRAWING NO. :

Figure 2

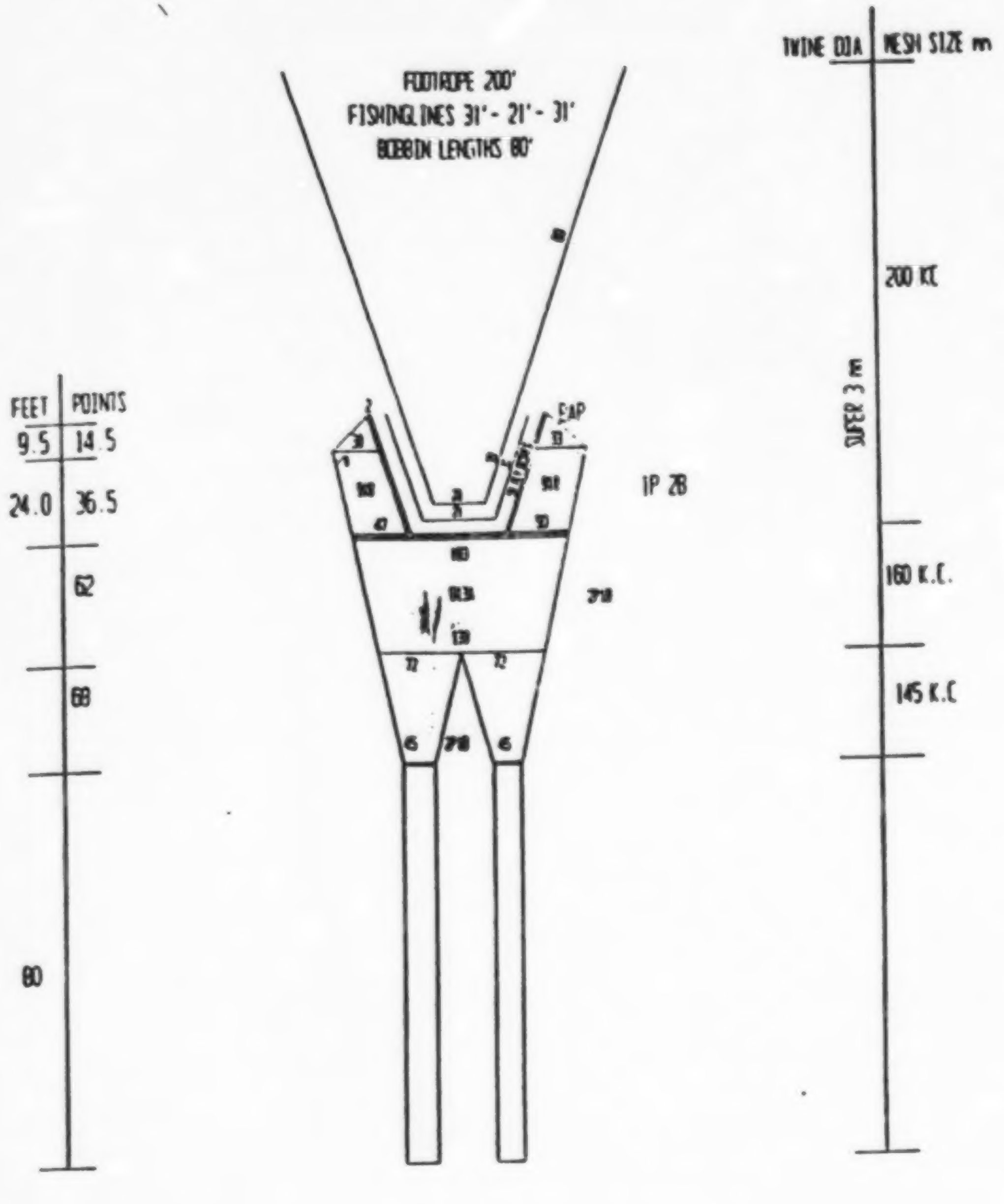

FEET | POINTS
34.5 52.5
34.5 52.5
29 44.5
62
68
80
5
HEADLINE 154'8''
80 FLOATS 8''0
30' - 20' - 30'
1P 1B
75
78
911A
BAR
911A
1P 4B
92
100
287
912A
227
1P 4B
227
913
144
1P 4B
72
72
2P 1B
45
2P1B
45
IM: INSIDE MESH
KC: KNOT CENTER

FISHERIES & OCEANS
INDUSTRY DEVELOPMENT DIVISION
NEWFOUNDLAND REGION

HAMPIDJAN
BI-LIFT TROUSER TRAWL

DRAWN BY: P. N. Snow
DATE : December 24, 1991
SCALE : SHOWN ON LEFT
DRAWING NO. : 2

Figure 3

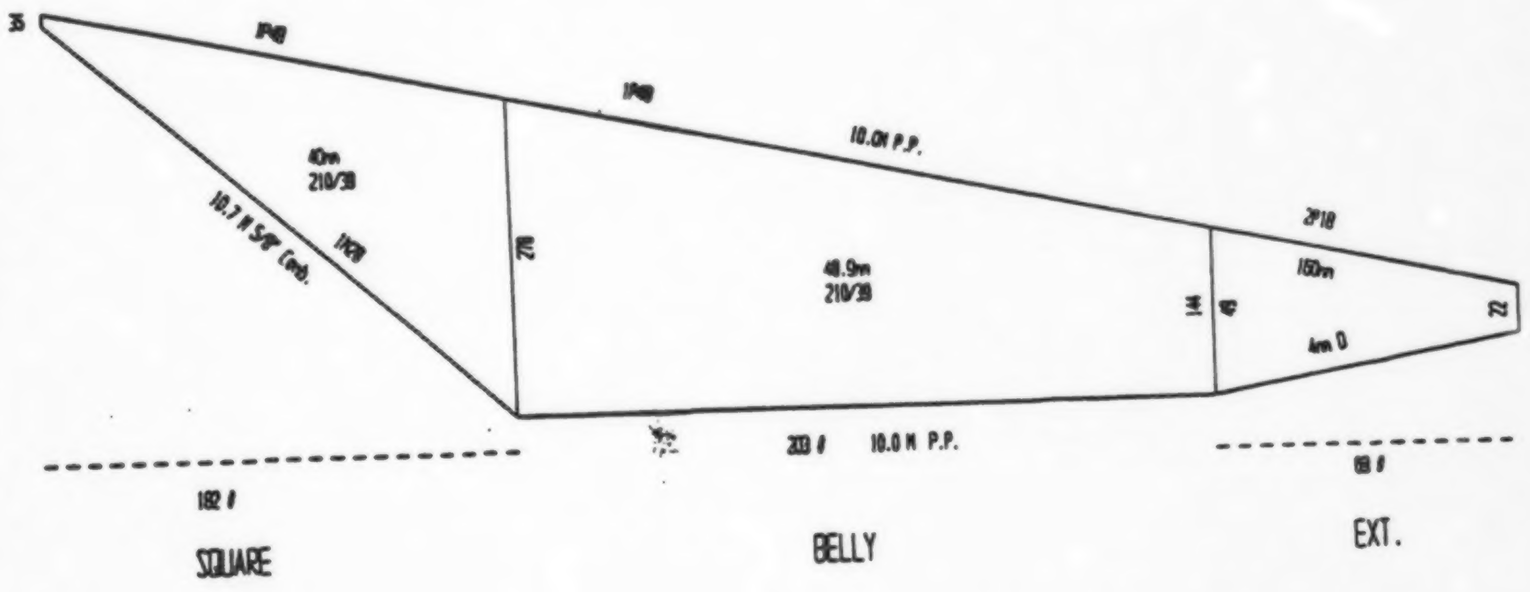

FOOTROPE 200'
FISHINGLINES 31' - 21' - 31'
BOBBIN LENGTHS 80'
FEET
POINTS
9.5
14.5
24.0
36.5
62
68
80
EAP
13
108
47
50
160
72
6
78
IP 28
TWINE DIA
MESH SIZE m
200 K.C.
SUPER 3 mm
160 K.C.
145 K.C

FISHERIES & OCEANS
INDUSTRY DEVELOPMENT DIVISION
NEWFOUNDLAND REGION

HAMPIDJAN
BI-LIFT TROUSER TRAWL

DRAWN BY: P.N. Snow
DATE : December 24, 1991
SCALE : AS SHOWN
DRAWING NO. : 3

Figure 4


35
1T4B
1T4B
10.0M P.P.
2T1B
40m
210/39
10.7 M 5/8" Comb.
1T2B
270
48.9m
210/39
144
45
150m
4m D
22
203 #
10.0 M P.P.
182 #
69 #
SQUARE
BELLY
EXT.

FISHERIES & OCEANS
INDUSTRY DEVELOPMENT DIVISION
NEWFOUNDLAND REGION

DRAWING TITLE: 154'8" Hi-Rise Trawl
Vertical Separator Panel

DRAWN BY:	P. N. Snow
DATE :	December 23, 1991
SCALE :	Not to scale
DRAWING NO. :	#1

Figure 5

ISOMETRIC OF TROUSER TRAWL

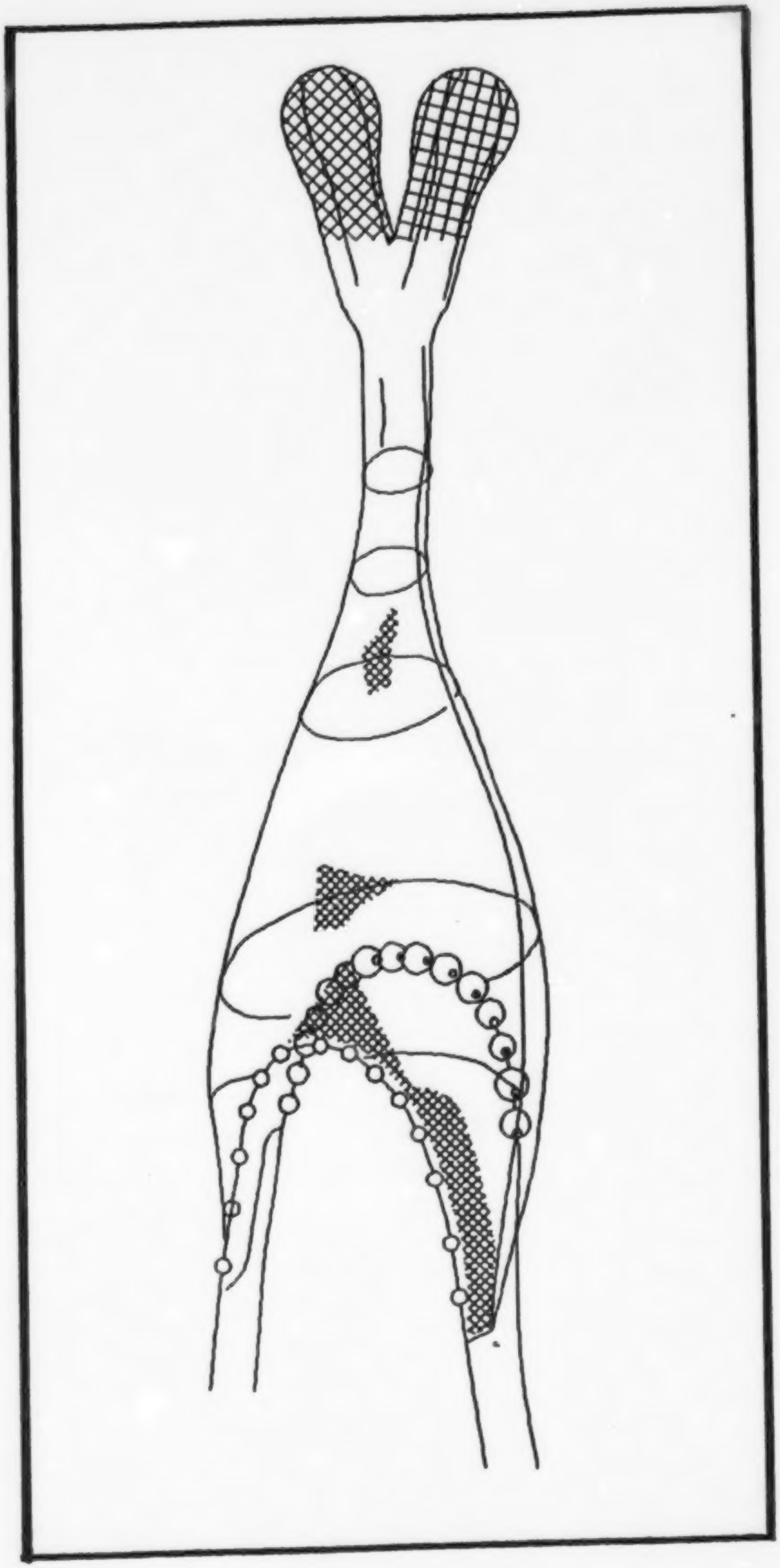


Figure 6

Square and Diamond Mesh Cod-Ends on the Scotian Shelf

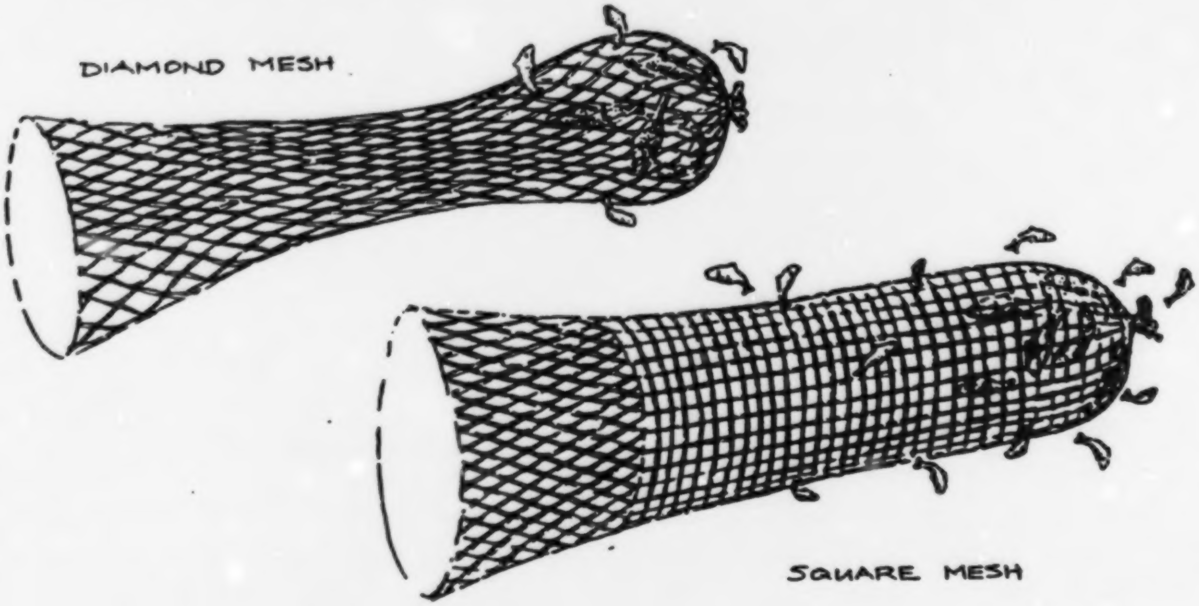

DIAMOND MESH
SQUARE MESH

Figure 7

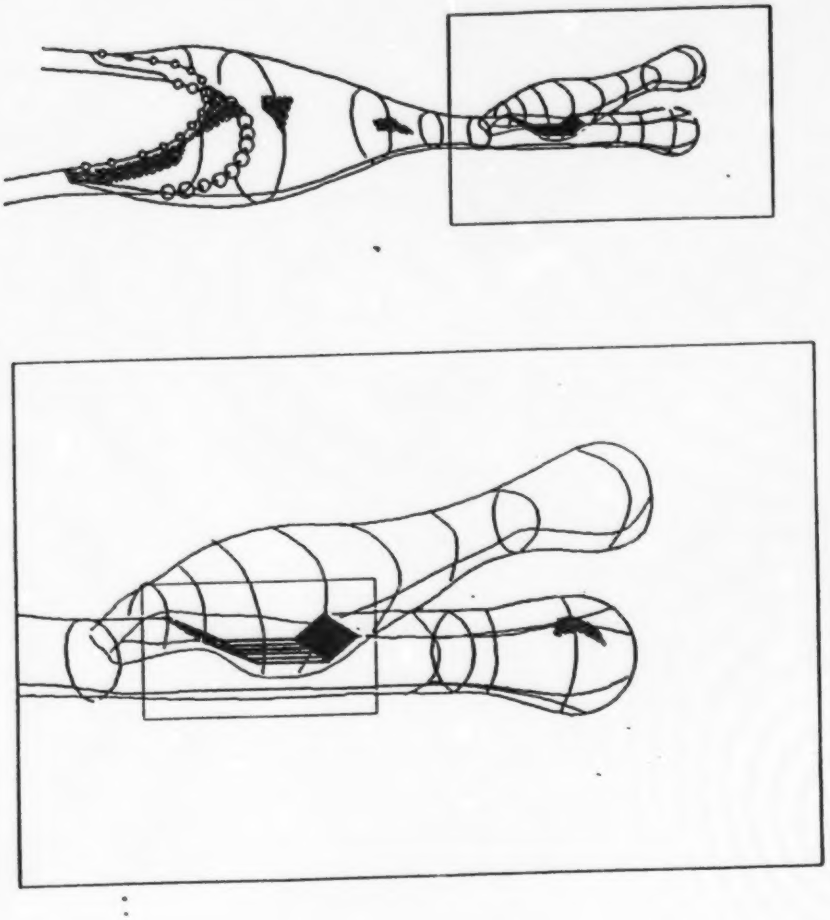
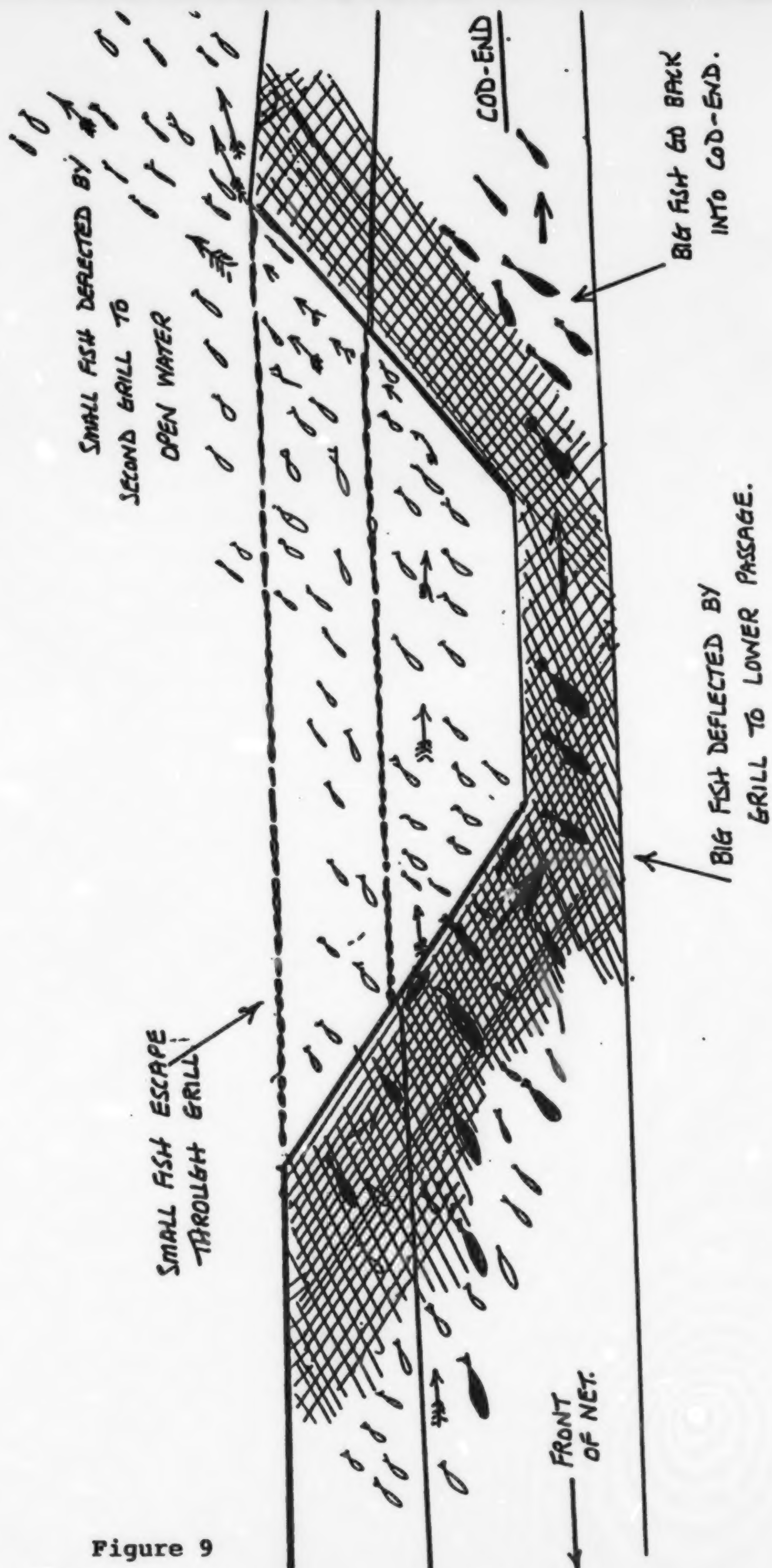


Figure 8


SMALL FISH ESCAPE THROUGH GRILL
SMALL FISH DEFLECTED BY SECOND GRILL TO OPEN WATER
COD-END
BIG FISH DEFLECTED BY GRILL TO LOWER PASSAGE.
BIG FISH GO BACK INTO COD-END.
FRONT OF NET.

ROUGH DIAGRAM SHEWING PRINCIPLES OF TROLLEX

Captain M. Hogan
OCT. 11 1990

Figure 9

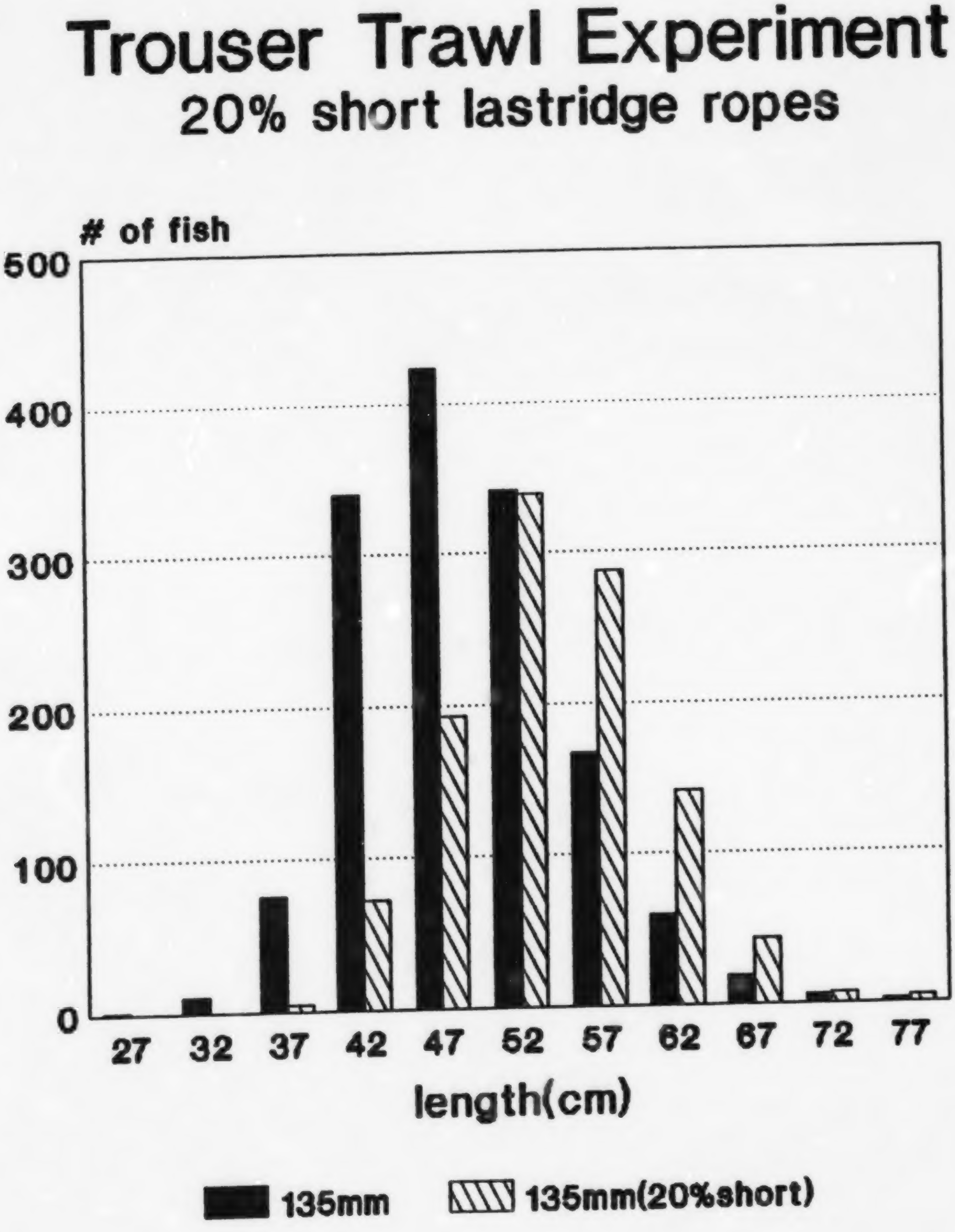

Trouser Trawl Experiment
20% short lastridge ropes
# of fish
500
400
300
200
100
0
27
32
37
42
47
52
57
62
67
72
77
length(cm)
135mm
135mm(20%short)

Figure 10

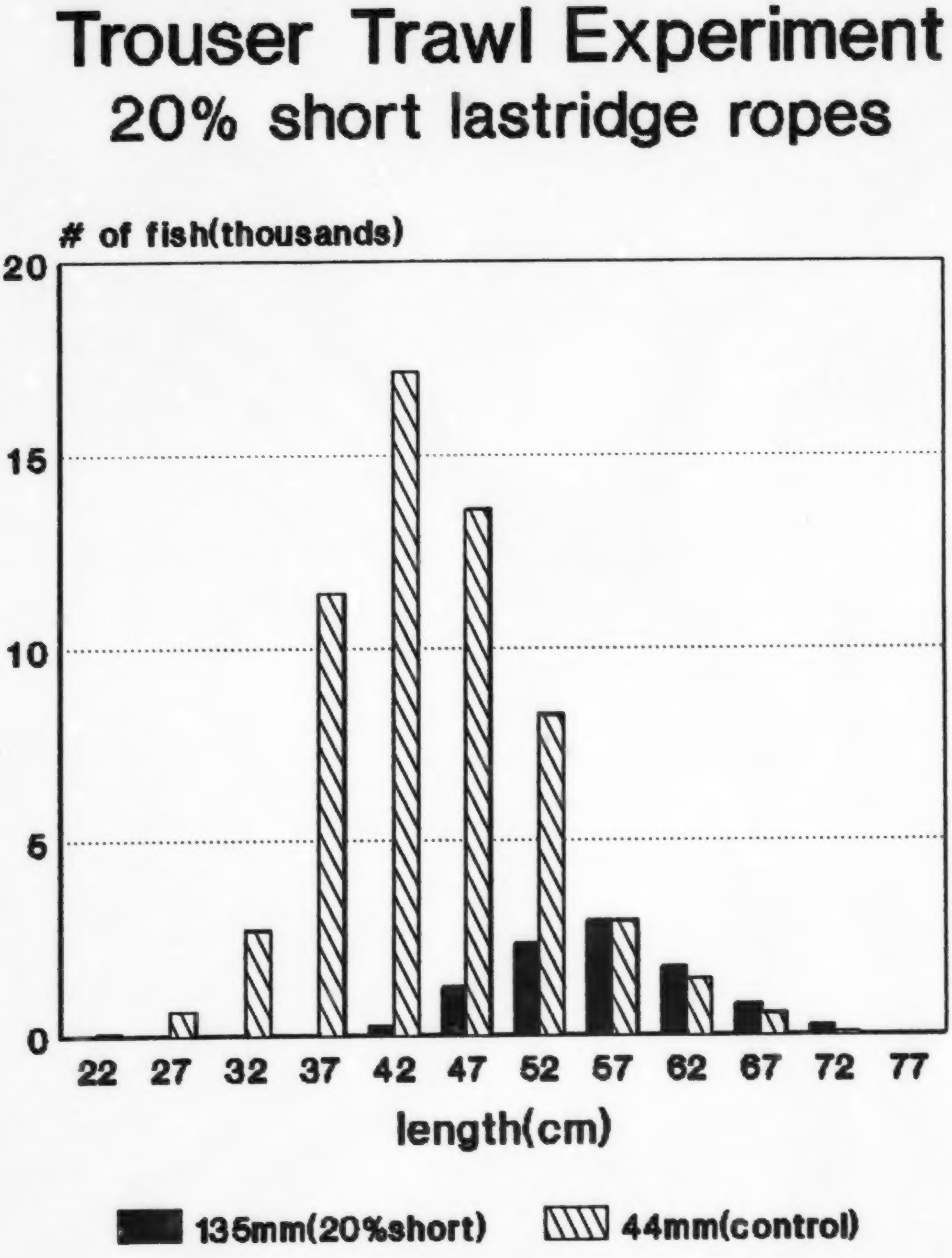

Trouser Trawl Experiment
20% short lastridge ropes
# of fish(thousands)
20
15
10
5
0
22
27
32
37
42
47
52
57
62
67
72
77
length(cm)
135mm(20%short)
44mm(control)

Figure 11

Trouser Trawl Experiment
15% short lastridge ropes

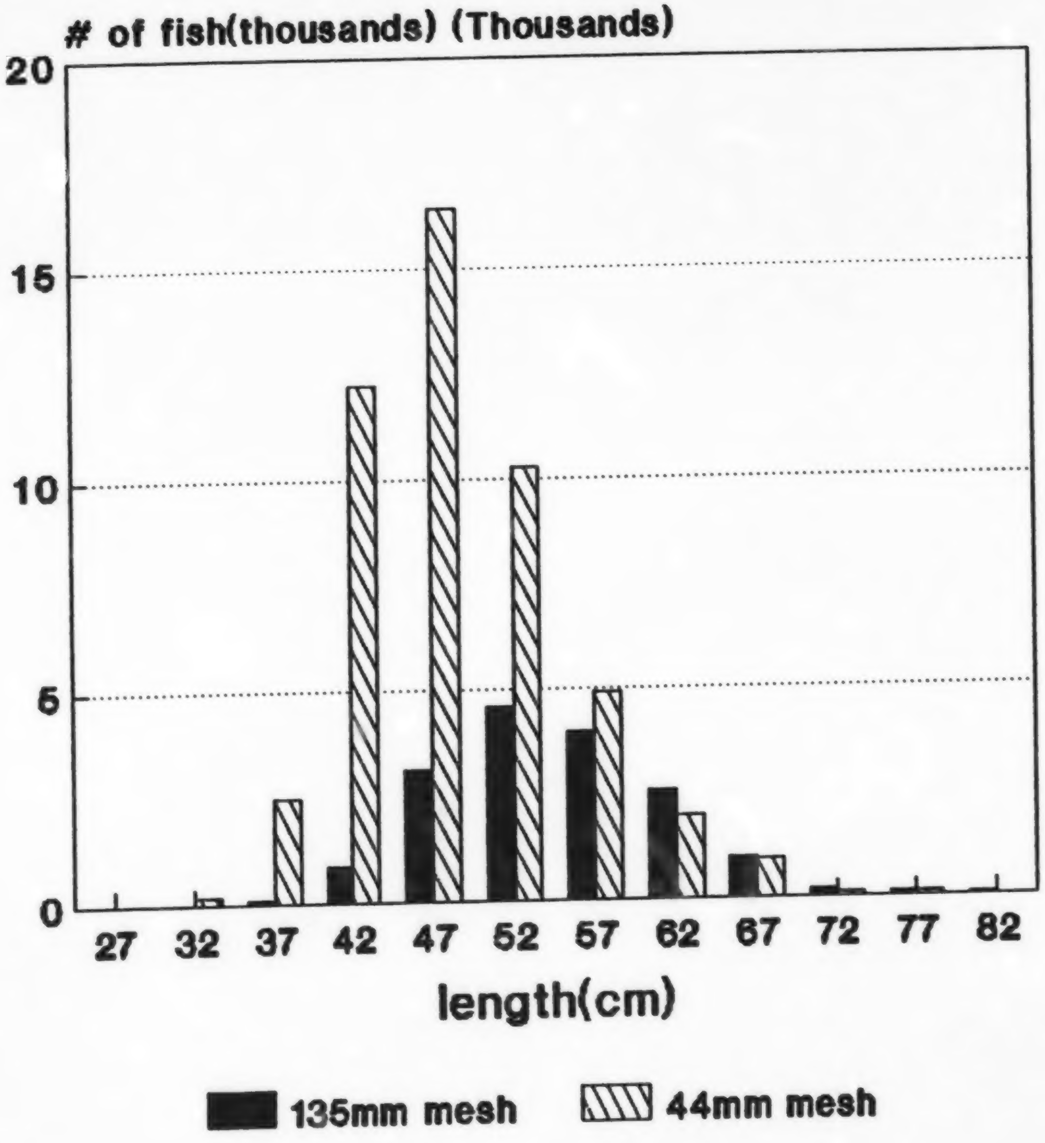


Figure 12

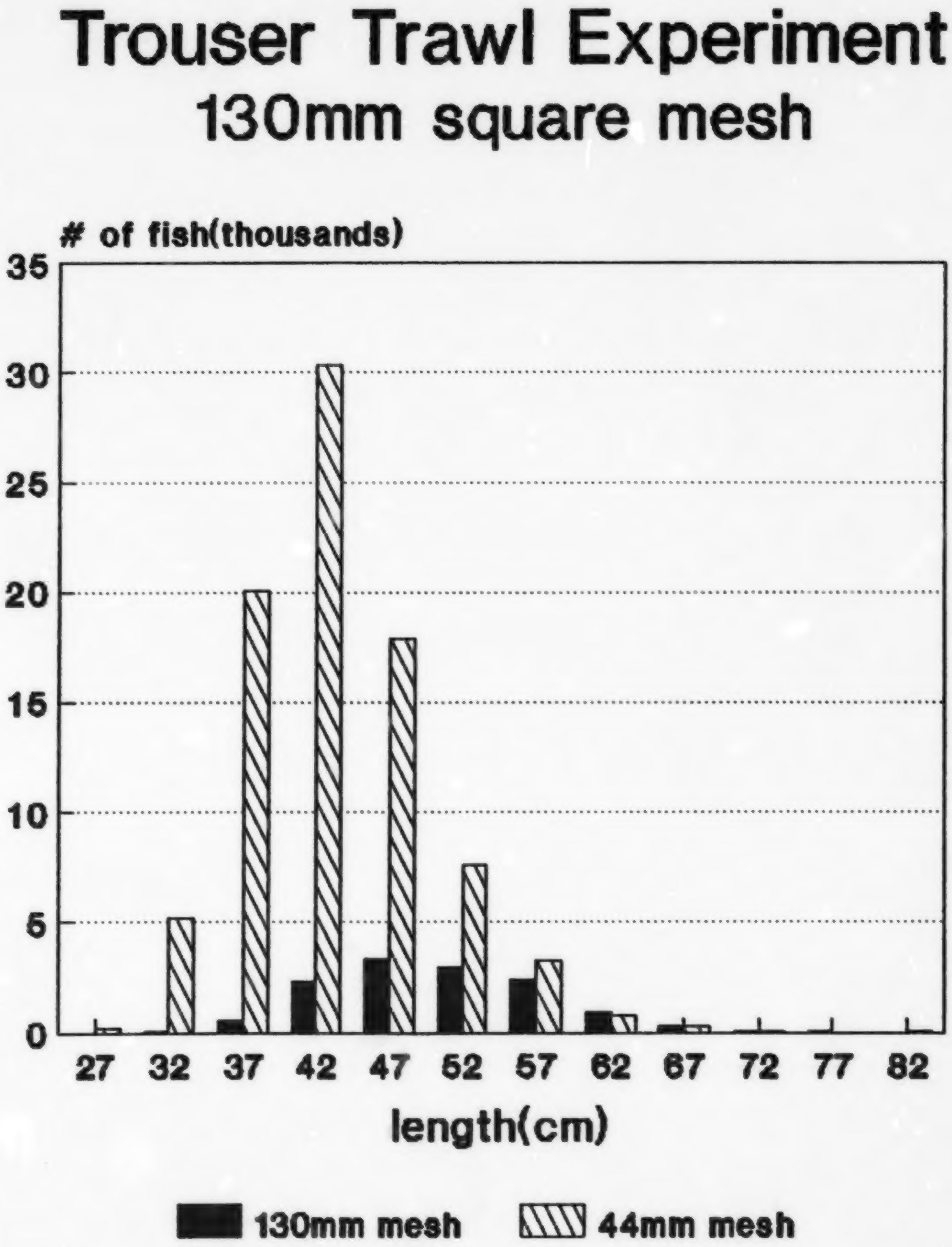

Trouser Trawl Experiment
130mm square mesh
# of fish(thousands)
35
30
25
20
15
10
5
0
27
32
37
42
47
52
57
62
67
72
77
82
length(cm)
130mm mesh
44mm mesh

Figure 13

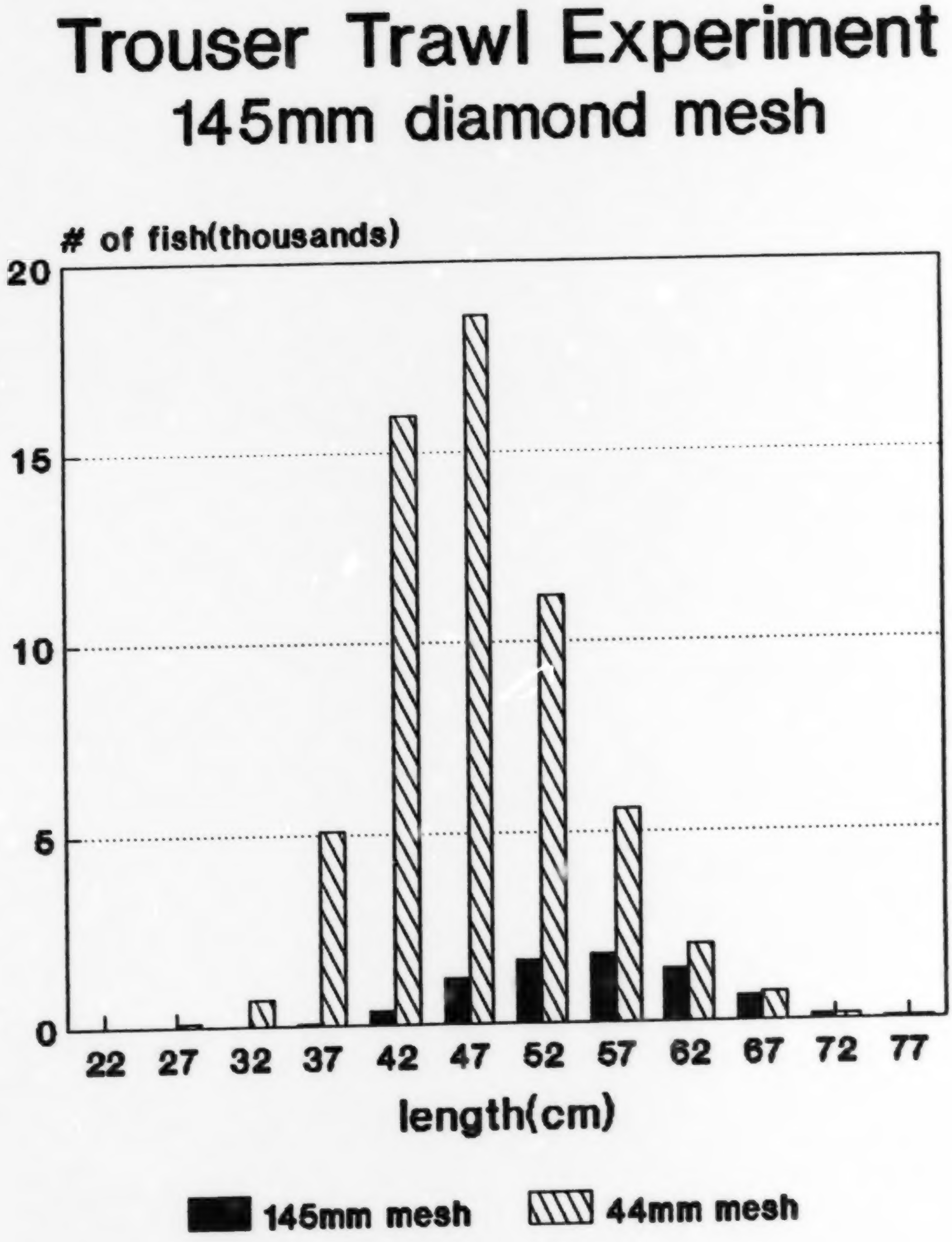

Trouser Trawl Experiment
145mm diamond mesh
# of fish(thousands)
20
15
10
5
0
22
27
32
37
42
47
52
57
62
67
72
77
length(cm)
■ 145mm mesh
▨ 44mm mesh

Figure 14

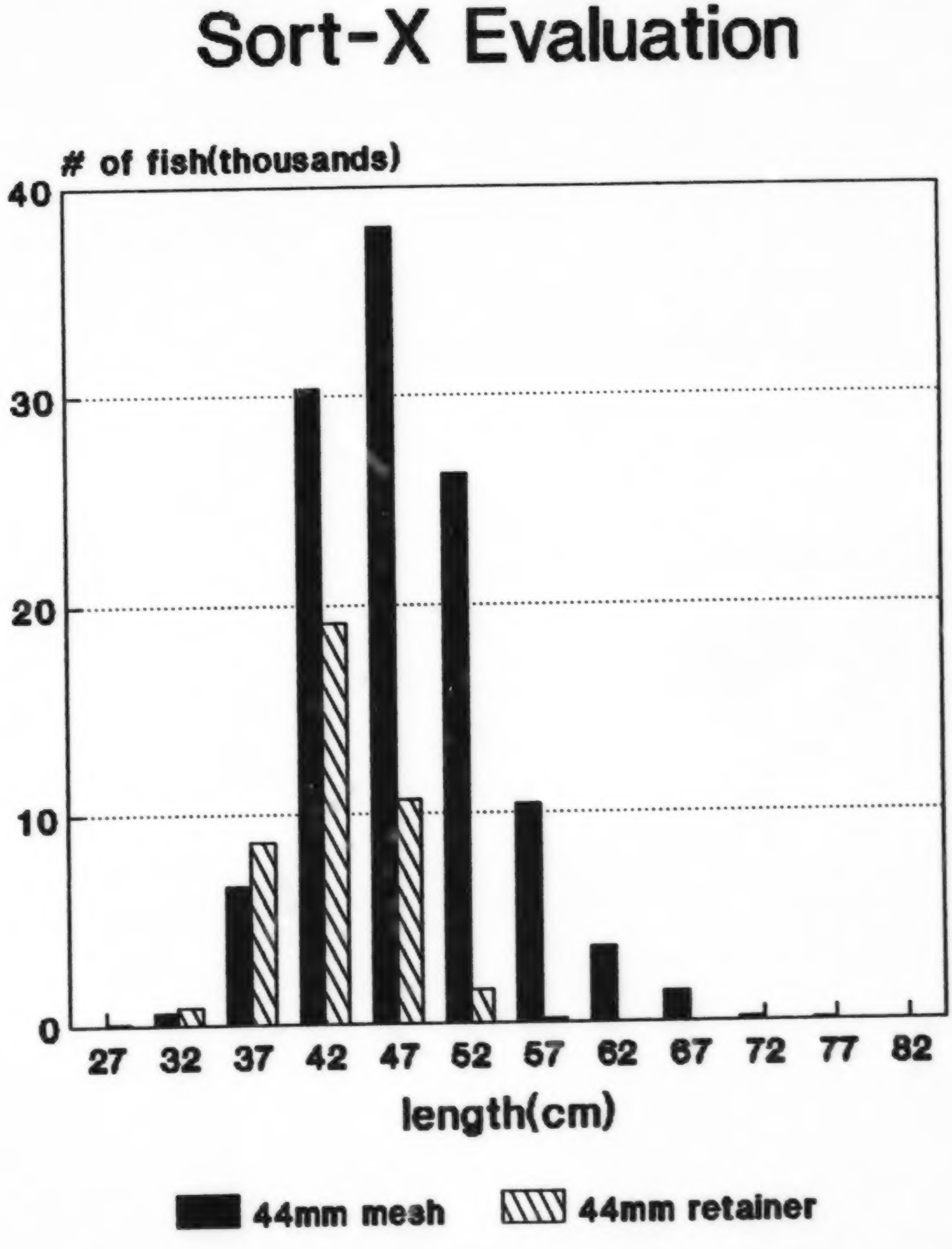

Sort-X Evaluation
# of fish(thousands)
40
30
20
10
0
27
32
37
42
47
52
57
62
67
72
77
82
length(cm)
44mm mesh
44mm retainer

Figure 15